ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. 34. No. 7. WEEKLY. | NEW YORK, WEDNESDAY, FEBRUARY 15, 1899. | $3 PER ANNUM. SINGLE COPIES, 10 CENTS.

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VIEWS, NEWS AND INTERVIEWS.

General Greely, chief of the signal service of the army, is preparing a cipher code for use in the army, which it is estimated will save the government some $50,000 or $60,000 annually in the cost of cable communication with Manila, Porto Rico and Cuba. The tariff to Manila is over $2 per word, and dispatches to General Otis have been found very costly. It was discovered by the department some time ago that a saving could be made by substituting a designation for the different heads of the war department, and, carrying this idea further, it was determined to supplement the commercial code now used by the adoption of a number of words to represent certain military phrases and sentences. The code, when completed, will comprise about 2,000 phrases and sentences, each represented by a single word. The saving by this arrangement will be about 75 per cent of the total number of words used.

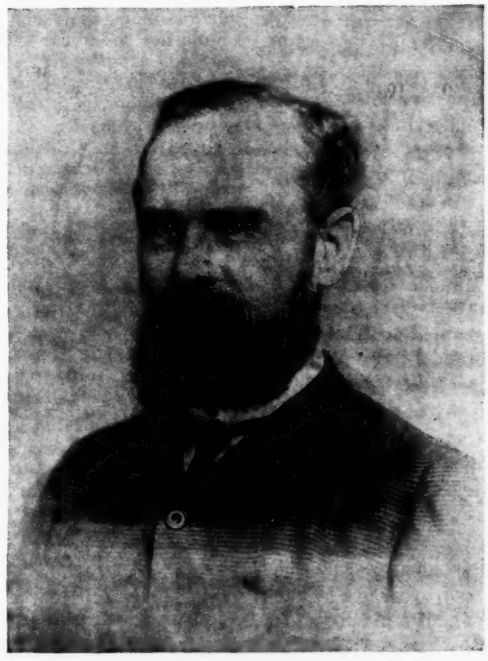
A curious fact is noted by M. Maurain in the *Journal de Physique*. He states the careful measurements of the intensity of gravitation made in different parts of the globe show this to be greater on islands than on continents.

The story is current in Niagara Falls, N. Y., that W. Caryl Ely, president of the Buffalo & Niagara Falls and Buffalo & Lockport electric lines, has enlisted New York capital in a project to connect Rochester and Toronto by a system of electric railways. Connection between Rochester and the Falls would be made by a route parallel to the New York Central most of the way; thence the route would follow an air line passing across the lower steel arch bridge to Niagara Falls, Ont, there connecting with the Niagara Central for St. Catharines. New lines would be built from St. Catharines to Toronto by way of Hamilton.

The Westinghouse Electric and Manufacturing Company has received an order for trolley cars, to be used in carrying tourists to and from the pyramids, in Egypt. A trolley line is being built by English capital from Cairo to the pyramids.

"Half-rate telegrams are rapidly becoming a thing of the past," said an official of one of the telegraph companies to the Pittsburgh *Dispatch*. "The new fast express trains that leave Pittsburgh in the evening are responsible for killing the business. Half-rate telegrams are those filed after six o'clock P. M. for delivery early next morning. Business firms here used to send thousands of them. Since the new trains were put on these firms now write letters and mail them instead of using the wire. We used to depend on these half-rate, or 'reds,' to keep our operators employed at night. The long-distance telephone has also hurt the business. It will be but a short time until there are no night telegrams."

The faculty of Harvard University has decided to expend $175,000 of the Henry L. Pierce bequest in the erection of a new building. Two-thirds of the building will be devoted to the courses offered by the department of engineering in the Lawrence Scientific School, the remaining third to such college uses as may be hereafter determined. The building of Pierce Hall may be said to be the final step in the system of confining the scientific departments of Harvard to that section of Cambridge north of Kirkland street which was begun by the erection of the Agassiz Museum and the Jefferson Physical Laboratory. The building will be situated on Holmes Field, fronting on Oxford street, and with Walter Hastings Hall will form a new quadrangle, thus making Holmes Field, famous in the past for athletics, a college yard.



THE LATE JESSE H. BUNNELL.

The Supreme Court of Appeals, of Virginia, recently rendered a decision in the condemnation case brought by the Postal Telegraph-Cable Company against the Farmville & Powhattan Railroad. The Supreme Court reversed the decision of the lower court and gives to the Postal the right of condemnation proceedings along all railroad rights of way.

DEATH OF JESSE H. BUNNELL.

THE PROMINENT WAR-TIME TELEGRAPHER AND ELECTRICAL MANUFACTURER PASSES AWAY.

Jesse H. Bunnell, the head of the firm of J. H. Bunnell & Company, of New York city, manufacturers of electrical supplies, died on February 8 at his home in Brooklyn, N. Y., from heart failure, following an attack of the grip. Mr. Bunnell was one of the most prominent of the old-time telegraphers and had been an important factor in the electrical field for many years.

He was born in Massillon, Ohio, in 1843. When he was 11 years old he secured employment as a messenger in the telegraph office at Massillon and in a short time became an expert operator. He returned to school in 1856 and continued his studies until 1859, in the meantime keeping up his practice as a telegraph operator. From 1859 to 1861 Mr. Bunnell was employed as an operator at several important telegraphic points in Ohio and West Virginia. In April, 1861, while he was employed in a telegraph office at Pittsburgh, Pa., he sent an imaginary account of a marine disaster by telegraph to the Wheeling newspapers and the next day when the hoax was discovered lost his position. He then went to Washington and was immediately employed in the military telegraph service by the government, in which he remained until August, 1864.

Mr. Bunnell took an active part in some of the most stirring scenes of the Civil War. He was attached to the Army of the Potomac and the Army of the Cumberland, serving at the headquarters of Generals McClellan, Burnside, Rosecrans, Thomas and Sherman as their personal telegrapher. At the battle of Antietam he set up his office on the field, and sent and received messages under fire. He was with General Rosecrans at Chattanooga, and after the flight of the right wing was the last man on the field. He remained on the spot and opened communication with Rosecrans. He rejoined the army at At-

lanta, but was so much overcome with the long hardships he had endured that he was unable to accompany Sherman on his march to the sea, and returned to his home in Ohio. All through his perilous service with the army he distinguished himself for coolness, discretion and bravery.

Mr. Bunnell was known throughout the fraternity as one of the most brilliant telegraph operators of his day, and especially as a "sender" of great speed. In December, 1860, on President Buchanan's last message to Congress, he made a two-hour record at the average speed of 38 words a minute, including a large proportion of very long words. This was a remarkable achievement in those days, and the reports of it were not credited by the foreign papers at the time. The work was done over the wire between Pittsburgh and Cincinnati, Mr. L. C. Weir being the receiver. The latter performed his task without a "break," and made eight manifold copies of the message. Mr. Bunnell remained actively connected with the telegraph service until 1871.

In 1872 he became a partner in the firm of Partrick, Bunnell & Company, of Philadelphia, manufacturers of telegraph and electrical supplies. From 1875 to 1878 he was connected with the firm of L. G. Tillotson & Company, of New York. From 1878 to the time of his death he was engaged in business for himself in the telegraph and electrical supply establishment bearing his name in New York city.

Mr. Bunnell devoted his especial attention to the manufacturing department of the business, which was kept distinct from the commercial and sales department, to the care and management of which his partner, Mr. Charles McLaughlin, devotes his entire time.

A widow, two sons and two daughters survive Mr. Bunnell. The funeral services were held on February 10, at St. John's Episcopal Church in Brooklyn, N. Y., and were largely attended by the numerous friends of the deceased.

The pallbearers were A. B. Chandler, Chas. A. Tinker, James Merrihew, F. W. Jones, Chas. W. Price, Robert S. Stewart, W. J. Dealy, Col. James Gilmore and Charles McLaughlin, all of whom were old-time friends of the deceased.

These gentlemen represented the Western Union and Postal Telegraph companies, the United States Military Telegraph Corps, and other electrical branches with which Mr. Bunnell had been identified.

ELECTRICITY ON BOARD SHIP.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS JANUARY 25, 1899, BY S. DANA GREENE.

While the title of this paper is intended to cover the applications of electricity aboard ship in the merchant marine, as well as in the navy, I shall confine my remarks principally to the war vessel; for the service requirements of electrical apparatus on the latter are quite as severe as on the former, while the limiting conditions as to weight and space are much more severe. It may be safely assumed, therefore, that any application which can be made to advantage aboard a man-of-war will be equally advantageous on board a merchantman.

On shore, the advantages of centralizing the manufacture of electric power for industrial purposes in one plant, distributing this power by suitable means to individual consumers, are so well known, and the industry is so well established, that it seems hard to realize the fact that it has all been accomplished in less than 20 years, and that it is less than 10 years since it was a difficult matter to interest capital in such undertakings.

For several years after the industry was well established ashore, little or nothing was done aboard ship. This was due principally to two causes:

1. Seafaring men are notoriously conservative about introducing new ideas or new apparatus aboard ship, which may not prove successful and which may on the other hand fail in the middle of a long voyage when facilities for repairs are not at hand and when a breakdown may be a very serious matter to the safety of the ship or the lives of the officers and crew. This conservatism is particularly strong in the British Navy, the greatest in the world, where no machinery is ever introduced when the work can be done as well by hand, and where "simplicity" is the first requirement for all machinery.

The modern warship is a complex piece of mechanism at best, and I think the established policy of our English cousins to eliminate rigidly all *unnecessary* complications is wise; one that can well be followed by other navies and particularly our own, where there has been a tendency to introduce too many novelties and labor-saving devices, at the expense of simplicity and safety.

2. Electrical men, while generally unfamiliar with the conditions of sea-life, knew nevertheless that three great enemies of electrical apparatus—salt air, moisture and heat—were always present aboard ship, and they feared them.

However, the great advantages of electric lights gradually overcame the sailor's conservatism and the electrician's fears, and lighting plants have been generally installed aboard ship for several years, in spite of numerous troubles at first both with the apparatus and with the wiring.

The great advances made in the construction of electrical apparatus and the methods of distribution enable us to say to-day, and to prove as I shall hope to prove, with a full knowledge of service conditions, that electrical applications can be made with as little fear and with as great certainty of success aboard ship as they can ashore.

The recent position reported to have been taken by one of the naval bureau chiefs, that such applications should not be further extended on our warships at present, because we did not have the trained men to care for the machinery, is, it seems to me, absolutely untenable. If it is demonstrated that an electric motor is better adapted to drive a deck winch, for example, than a steam or hydraulic or compressed air motor, then it should be installed and the necessary men to operate it can and should be obtained. If the course suggested by the naval officer referred to had been followed in our navy for the past 50 years we would still have sailing vessels (the frigates and line-of-battle ships of Nelson's day), and our recent unpleasantness with Spain would have terminated with very different results.

Assuming, then, as every reasonable man both in and out of the navy does assume, that electrical apparatus can be made to work on shipboard, let us examine the conditions of the modern war vessel as we find them, and see where electricity can be advantageously introduced, having in mind always the necessary requisites—safety, simplicity, efficiency and reliability.

The modern first-class battle ship requires about 2,000 indicated horse-power to drive all the auxiliaries at full load, and the first-class cruiser about 1,200 indicated horse-power. These auxiliaries, however, are never all in use at the same time using maximum power, and it can be assumed that only about one-half these amounts (i. e., 1,000 indicated horse-power and 600 indicated horse-power) will be required at any one time. They are scattered all over the ship, from the anchor hoist forward to the steering engine aft, and from the deck winches and boat cranes on the spar deck to the bilge and fire pumps in the engine and fire-rooms, 30 or 40 feet below. Some of them, such as condenser, air, circulating, feed, bilge and fire pumps, and fire-room blowers, are necessarily located within the engine and boiler-room compartments, where the temperatures are always high and where steam, oil, water and coal dust are always present in greater or less quantities. Others, located on the spar deck, are exposed to salt water and air and to the varying conditions of sea and weather.

With these scattered locations, it is obvious that power, generated at a central point, must be distributed throughout the ship. For this purpose there can be used either steam, hydraulics, compressed air or electricity. Hydraulics and compressed air not only have a low efficiency of conversion (from steam), but is difficult to prevent leaks, freezing, bursting of pipes, etc. They have both been tried to a limited extent and both found wanting in service. This leaves steam and electricity as the two remaining systems of distribution from which to choose. As between the two, steam has the following disadvantages:

1. Danger to life—The bursting of a steam-pipe, whether in or out of a fight, is a serious matter and likely to disable any of the crew who are in the compartment where the accident occurs. It has been abundantly proven in our Civil War, that men will not stand up against steam or hot water, when they will face shot and shell without flinching. Many of our vessels operating in inland waters during that war had several lines of hose coupled to a hot water tank and led out every night to guard against boat attacks. These hoses were successful on more than one occasion in repelling boarding parties. While the main steam leads fore and aft can be run below the protective deck or behind the armor belt, vertical branches must run to all auxiliaries on the upper decks and many of these must be used in action. The effects of a steam-pipe carrying 100 pounds pressure, bursting or being shot away in a compartment where there may be 30 or 40 men, at the guns or passing ammunition, would undoubtedly be to kill or disable every man in the neighborhood and demoralize thoroughly that part of the ship. On the other hand, if a wire is shot away, one or more auxiliaries may be disabled but no one is injured; furthermore, the wire presents a much smaller target than a steam-pipe, and is therefore less liable to injury from shot. It is always a difficult matter, too, to keep steam and exhaust-pipes tight and to prevent leaks at the joints and at water-tight bulkheads.

2. Injurious heating of living quarters—Steam and exhaust-pipes must necessarily run to every auxiliary, and some of the latter, such as the ice machine, anchor hoist, steering engine, ventilators, etc., are in the officers' and men's quarters, or the pipes leading to them must pass through these quarters. The heat of the pipes and engines not only makes the quarters uncomfortable, but it is impossible to prevent more or less oil and dirt around the auxiliaries. In the tropics, the heat is often so great that the officers and men can not sleep below at all. This was the case on a number of our vessels operating in Cuban waters last Summer.

(To be continued.)

ROENTGEN LIGHT NOTES.

BY WILLIAM ROLLINS.

NOTE L—ROTARY TARGETS.

In Note xi, January 5, 1898, I described a revolving target tube for experimental work. As I am not aware that such a thing is being commercially produced, I consider it desirable to illustrate it in practical form, for if one does not care to use the cooled target tube shown in Note i, December 1, 1897, he will constantly be embarrassed by having his tube ruined by perforation of the target soon after it gets in prime condition. There is such a terrible heat from the impact of the stream of Crookes radiant matter that no known substance can endure unless it is cooled. Platinum melts like ice in the sun when any considerable amperage is used. Increasing the thickness of the metal retards the inevitable, but a simpler way is to make the target revolve, thus bringing fresh surfaces to receive the cathode stream. In Fig. 52 I show such a tube in its simplest form, though here the revolving is not automatic. Fig. 53 gives the target full size. Fig. 142 should have been published with Note xlix, but, owing to carelessness in forwarding, it was received too late; I therefore write this note sooner than was intended to give it place.

NOTE LII—LIGHT GASES.

There are present in the air gases in comparison with which hydrogen is heavy. A scientific man would not make this statement on the evidence I possess, but as such things are with me only what a poet has called "considerations by the way," I do not hesitate.

Since Roentgen's discovery was announced I have had tubes under observation for a great number of hours, because having constructed an apparatus which runs continuously without either noise or attention for any length of time, I have usually had a tube excited all day for many days in succession, in order that I might, during the intervals of work, glance at it to see if there was anything new to think about. As a result I imagine there is a period of maximum efficiency to which an ordinary tube never after attains until it is again opened to the air and repumped. When the vacuum gets too high it is a simple matter to lower it with either my oxygen or hydrogen regenerators so that the tube may be run indefinitely without repumping, but we do not restore the pristine brilliancy which has gone, as Omar would say—"with the rose of yesterday." I explain this perhaps vain imagining by saying there are unknown gases of extreme lightness. I am aware that Crookes considers Mr. Brush's etherion to be only water vapor, but perhaps this may only show either "what need there is to be reserved in speech," or how desirable it is to study water vapor. I believe that some metals—aluminum, for example—contain these new gases, and that the initial maximum radiance is due to them. Such light gases would be projected in the Crookes stream with enormous velocity against the target and raised to a high temperature by the shock, generating waves of short length. Having this in mind, I constructed a tube on the principle of my intermolecular hydrogen regulator, the regenerator being of aluminum. I also made a tube with a hollow aluminum cathode, as mentioned in Note vi, December, 1897, the theory being that, as the aluminum was in contact with the air on one side, the gases might be caused to pass through to supply the loss. I shall some time have more to say about this. In the meantime, some one with abundant time may possibly be interested to work on it. Some statements in this note may appear inconsistent with what was said in Note xxvi, but they are not so much so as they seem, and if they were, what matter? Has not Emerson said, "Consistency is a vice of small minds?"

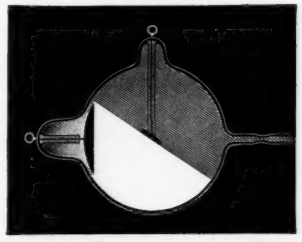


FIG. 142.—FROM THOMSON'S "LIGHT, VISIBLE AND INVISIBLE."

NOTE LIII—ON THE EQUIVALENT AIR GAP.

In Note xxxv it was said that it was unsafe to record the length of the equivalent air spark as a measure of the degree of the vacuum in a tube, that other data should be given. Recently in attempting to make a generalization from my experience with vacuums I found my early observations useless, because I had relied on this ancient and comparatively useless measure. I therefore point out some things which should be considered with it to make the records of value: The distance between the terminals; the form, area, nature and temperature of the terminals; the shape of the tube; the kind of gas; the length of time the tube has been used; the voltage and amperage of the current; the kind of generator, including the form, size and rapidity of the surges.

NOTE LIV—MULTIPLE PHOTOGRAPHY.

In this journal for July 1, 1896, I described what I thought was a new principle in radiography, consisting in taking several photographs at one exposure. I have since learned that Prof. E. Thomson was the discoverer of this plan. However, as I do not see his method in use, I venture to call renewed attention to it, for Professor Thomson is so occupied with other things that he probably would never take the time to mention it again. What a surgeon wants, when he sends a patient to the Roentgen laboratory of his hospital, is to have a picture of the injury delivered to him in a few minutes, so that he can at once use it in his diagnosis. When he finds he must wait some hours, or a day or two, he instinctively avoids the method, his time being too valuable to lose. Professor Thomson's method enables him to get not one, but a number of positives in a few minutes, one of which will almost surely be better than would be the single plate taken in the usual way. The method consists in placing half a dozen sheets of bromide paper in a pile, and on top the part to be photographed. On developing all the prints together in one dish at the same time, six positives are obtained instead of one negative, and, by flooding these with alcohol, they can be dried at once.

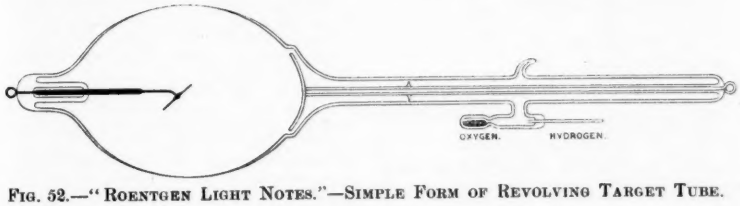


FIG. 52.—"ROENTGEN LIGHT NOTES."—SIMPLE FORM OF REVOLVING TARGET TUBE.

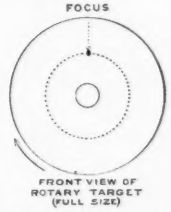


FIG. 53.—FULL SIZE VIEW OF REVOLVING TARGET.

NOTE LV—CONCAVE ANODES.

There is nothing new in the idea of concave anodes, several experimenters having used them, notably Dr. Girdwood, of Montreal, but I have never seen any statements of the reasons why this form was tried. I mention one or two appearances connected with it which may be of interest. First, as shown in Note xlix, the girdle is broader and further forward than with the flat anode. Second, instead of the corona, as shown in Fig. 51, Note xlix, there is a brilliant sun of smaller size than the anode and situated on the wall of the tube where the particles would strike, if they went off normal, to the surface of the anode. This sun is surrounded by a halo. Third, there is less discharge from the back of the anode. Therefore as the tendency in a vacuum tube is for the particles to collect at the anode end of the tube, giving rise to uneven pressure, this form of anode has the advantage of sending most of the anode rush toward the cathode end, thereby, perhaps, helping to equalize the pressure and being compacted it should interfere somewhat less with the Crookes stream. Being as simple to make a concave anode rotate as though it were flat, it need not burn out any faster.

The Trolley on the Nile.

[*Cleveland Plain Dealer.*]

Whizzing o'er the desert—
My! what heaps o' sand!
Gracious, there's a camel!
See the Dervish band!
Isn't this delightful?
Glad we came so far—
Scootin' down from Cairo
In a trolley car!

Here is th' conductor—
Looks first-rate in blue;
Glory, he's a Yankee—
So's the motor, too!
See that dirty 'Gyptian
With th' water jar;
Glad we came from Cairo
In a trolley car!

Think of poor Cle'patry,
Playin' her high jinks!
Don't forget th' transfer—
Mus'n't miss the Sphinx.
Guess that's a Be-doo-an,
Smokin' his cigar.
Here we come from Cairo
In a trolley car!

Say, th' car is slowin'—
Wonder where it stops?
Yes, the journey's over—
There is old Chee-ops.
Makes you feel real creepy
Thinkin' where you are!
Hustled down from Cairo
In a trolley car!

FOREIGN ELECTRICAL NEWS.

Telephonic Extension in France—Telephone communication is now possible between Paris and Brest, and, in fact, with all parts of Brittany. For some time past Paris has been in telephonic communication with Rennes, Nantes and St. Malo, but Brest and the extreme west of Brittany were overlooked when the extensions were being carried into effect. As Brest is a military port, the extension assumes more importance than would at first appear. The new line is by way of Rennes, St. Brieux and Morlaix. Another line, between Brest and Paris, by way of St. Malo, Forgeres, Vitre, Nantes and St. Nazaire, is also to be constructed shortly, and the military authorities are contemplating the erection of a line between Brest and Cherbourg.

Electric Lighting in Vienna—A German contemporary, *Zeitschrift für Elektrotechnik*, describes the distribution of electric energy along the municipal tramway lines in Vienna for the purpose of public lighting. The central station comprises three steam generators, having a heating surface of 240 m² and working under a pressure of 10 atm. Motive power is produced by two series of steam machines of two cylinders each; each series being of 600 horse-power. The line is necessarily lighted by electricity, nine arc lamps to a series. The tension of the current is 480 volts and there are four kinds of lamps in use, twelve, eight and six amperes, respectively. The distance between the lamps varies from 50 to 100 meters, the current being transmitted to them by the underground system. In addition to the arc lamps there are incandescent lamps used in lighting vestibules, offices, waiting-rooms, etc., the tension of the current in this case being 240 volts, and the lighting capacity from 16 to 50 candle power.

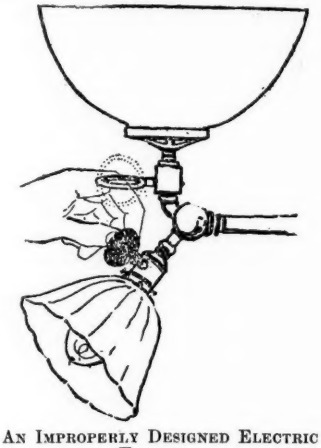
Electric Traction on Canals—This is now engrossing the attention of some of our electrical friends in the Low Countries. *L'Electricien* says: "The promises for the future in regard to the application of electricity for this purpose are already partly realized. The General Electric Traction Company, of Belgium, the company most interested in electrical propulsion on navigable ways, established at Brussels in November last, is about to give great incentive to the work." The life of the company has been fixed for 30 years; its nominal capital is 1,500,000 francs, and it is to be remarked that it is really more French than Belgian, since 10,250 out of the 12,000 100 franc shares that it has offered for public subscription have been taken up in France. The aim of the company is very extensive, and comprises the propulsion of boats of all countries, and the exploiting of electrical energy in all its forms. It will be assisted in its work by the Denefle-Gaillet Electric Company, of Paris, another concern interested in electric traction on rivers and canals, and which will receive in return for its services 1,800 francs for every kilometer of navigable way that the two companies will exploit in Belgium or elsewhere. The former company has already secured the franchise for the canal between Brussels and Charleroi, and it is expected that they will also obtain control of the canal from Gant to Terneuzen.

Telephone Communication between Belgium and Germany—This has been established, and, it is reported, at a price unheard of in the history of the telephone business. By royal decree, the Belgians are informed that telephonic communication between Brussels, Liège and Vervièrs, on the one side, and Frankfort, Hêchet, Hanau and Hoffenbach, on the other, will cost as follows: one thaler for ordinary communications, and three thalers for urgent calls, the duration being limited to three minutes.

The Microphonograph—This is one of the latest inventions for which we are indebted to the French. The inventor is M. Dussaud. The instrument is intended for the benefit of the deaf, and it is reported that remarkable results have already been obtained with it in the cure of deafness. The microphonograph is constructed by the Paris Telephone Company, and such well known experts as Messrs. Turner, Bailleux and Pitheis are interested in it. The instrument is composed of a phonograph, the membrane of which acts on a microphone, which reproduces the sounds in the telephone receiver. A single receiver was capable of making itself distinctly heard by 1,000 persons who gathered for the purpose in the hall of the University of Geneva on November 11. The Paris Telephone Company has just constructed 12 of these microphonographs, each one of them capable of reproducing sounds in 100 telephone receivers. Theoretically, this would mean that 2,000,000 persons could listen to the same singer at the same time; but practically, the number is much reduced. The instrument is capable of reproducing sounds originated at a considerable distance, and, by regulating the current, these sounds can either be heard in whispers, or as strong as the human ear can stand, even for the fractional part of a second.

Two Deaths Due to an Improperly Designed Electric Fixture.

Dr. H. E. Keyes and his wife were found dead in a room at the Ardsley Casino, at Ardsley-on-the-Hudson, N. Y., early on the morning of February 7. They had been accidentally asphyxiated by gas, which it is believed Dr. Keyes inadvertently turned on just before retiring. The unfortunate couple had been attending a barn dance at the residence of General Griffin, first vice-president of the General Electric Company, who lives at Dobbs Ferry. Dr. and Mrs. Keyes had arranged to stay over night at the Casino.



AN IMPROPERLY DESIGNED ELECTRIC FIXTURE.

From the accompanying sketch it will be readily understood how it was that Dr. Keyes caused the accident which resulted in the death of himself and his wife. The Casino is equipped with both electric and gas light, the electric current having been in use on the evening in question. In turning off the key in the lamp socket it is probable that Dr. Keyes's thumb or fingers struck the gas key, which must have been quite loose, and accidentally turned it about three-fourths around. The result was that sufficient gas escaped to kill the two occupants of the room.

The proper design for the combination of electric and gas-light fixtures is a subject of vital importance, and the location of the two respective keys should be as far apart as practicable. It seems to the ELECTRICAL REVIEW that the designer of a fixture of the sort here sketched comes pretty near being guilty of criminal negligence.

LONDON AND BIRMINGHAM UNDERGROUND CABLE.

A CABLE FOR TELEGRAPH AND TELEPHONE WORK BEING LAID UNDER GROUND A DISTANCE OF 116 MILES.

The paper-insulated cable now being laid between London and Birmingham will be the longest of the kind that has hitherto been undertaken, and its progress will be watched with great interest in view of the important results which may follow from its successful completion.

The cable used is of the lead-covered paper-insulated air-space type, and is being manufactured by the British Insulated Wire Company, Prescot, and the Western Electric Cable Company, North Woolwich.

The general terms of the specification are as follows:

"CONDUCTORS.

"Each conductor to consist of a solid wire of pure annealed copper, smoothly drawn, cylindrical, uniform in quality, free from all defects, and having a standard weight of 150 pounds per statute mile, and measuring neither less than 96 nor more than 98 mils in diameter.

"The minimum conductivity of the copper to be 100 per cent according to Matthiessen's standard of pure soft copper.

"The maximum resistance per statute mile at 60 degrees Fahrenheit to be 5.852 standard ohms.

"The wires in each length should be free from joints.

"DIELECTRIC.

"Each pair of conductors to be wrapped with strong, specially prepared paper, free from metallic particles, in such a way as to completely enclose the wires, and to perfectly insulate them both from each other and from neighboring conductors. During the wrapping process the conductors of each pair are to be uniformly twisted so as to make at least one complete turn in every 12 inches. The insulated pairs are then to be stranded into a compact and symmetrical cable, the following arrangement to be maintained throughout: Center, one pair; first layer, six pairs; second layer, 12 pairs; third layer, 19 pairs.

"Additional paper insulation is to be laid on spirally between each completed layer of pairs, so as to form a suitable bed for the next layer. A final wrapping of at least one thickness of paper, or of other suitable fibrous material, is to be added between the outer layer and the lead sheath hereinafter described. The cable thus formed is to be carefully and thoroughly dried at a temperature not exceeding 225 degrees Fahrenheit.

"LEAD SHEATH.

"The cable to be sheathed with the finest English lead, applied at a temperature not exceeding 600 degrees Fahrenheit. The lead sheath to form a perfectly continuous, cylindrical tube, free from pinholes, defects and flaws of every kind, and to have a uniform thickness of 160 mils. Its diameter is not to exceed 2.625 inches as an absolute maximum measured across its major axis, no margin being allowed beyond this figure. The sheath of any single length of cable to contain no mended place whatever.

"CAPACITY.

"(*a*) The electrostatic capacity of each wire measured against all the remaining wires of the cable, and the lead sheathing as earth, shall not exceed one microfarad per mile at a temperature not less than 50 degrees Fahrenheit.

"(*b*) The mean electrostatic capacity

from wire to wire of each pair in any length, all the wires in the cable, and the testing battery and apparatus, being insulated, shall not exceed .65 microfarad per mile.

"INSULATION TEST.

"The insulation resistance, when tested, to be not less than 10,000 megohms per statute mile after one minute's electrification at a temperature of not less than 50 degrees Fahrenheit. The galvanometer readings during the test to indicate perfectly steady electrification.

"The cable to be tested dry, and the ends to be metal capped and sealed immediately the tests are completed.

"The insulation tests to be made with not less than 600 volts."

The cable is drawn into three-inch cast-iron socket pipes, laid in sections of 150 yards, leaving a gap between the sections of four feet two inches for the purpose of jointing the sections of cable. These pipes are laid at a depth of two feet below the surface of footways, and two feet six inches below the surface of roadways, which depths will insure against crushing by heavy weights passing over the roads. As a further safeguard the cable is laid under footways wherever footways exist.

The pipe laying is done by contractors, under the supervision of the engineer in charge, and special precautions are taken to insure that the pipes are full bore, clean and free from any projections or roughness on the inner surface. The person who inspects the pipes on the ground is a responsible officer of the department, and the method of inspection is as follows: Each pipe is laid on trestles breast high; a gaging disk two fifteen-sixteenths inches in diameter attached to the end of a long iron rod is passed through the pipe to prove the bore; a bright sheet of tin is then held a few inches away from one end of the pipe, and this enables the inspector, by looking through from the other end, to see clearly the whole of the inner surface of the pipe. If accepted as a suitable pipe, it is marked and passed on to the pipe layers.

The trench is dug in as straight a line as local conditions will permit, and the sections of pipes are regulated by the department's officer before the ground is allowed to be filled in.

An iron wire is threaded through the pipes as they are laid, for the purpose of drawing the pulling rope into the pipes, and as each section of pipes is completed this wire is turned into the mouth of the pipe, and a plug of hard wood inserted to keep water and grit from entering.

As the pipes are being laid a chart is prepared giving measurements, in order that the jointing places can be readily identified by the cable gang.

At the present time four contractors are engaged laying pipes, viz.: Mr. Peattie, of Oxford, Mr. Atkins, of Kingston-on-Thames, Messrs. Worthington & Pownall, of Manchester, and Messrs. Reid Brothers, of Wharf Road, City Road, London.

The drums of cable are drawn from the railway depot to the works on specially constructed carriages, or "floats," horsed by local contractors. A joint hole is opened up by the cable gang, a drum of cable is placed in position and mounted on screw jacks, over the hole, the pulling clip is attached to the end of the cable, the end of the cable with clip attached is then dipped into a saucepan of boiling paraffin wax in order to fill up all

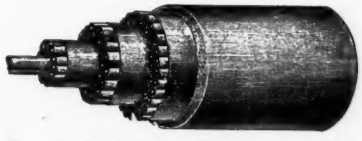


FIG. 1.—SECTION OF LONDON AND BIRMINGHAM UNDERGROUND CABLE.

interstices, and thus prevent any water which may have accumulated in the pipes from penetrating to the core of the cable.

One end of the pulling rope is now made fast to the iron wire before mentioned, and at the same time a sponge of white yarn is attached so that as the pulling rope is being drawn through the pipes the sponge clears out any grit which may have found its way into the interior. The other end of the pulling rope is then passed round the barrel of a crab

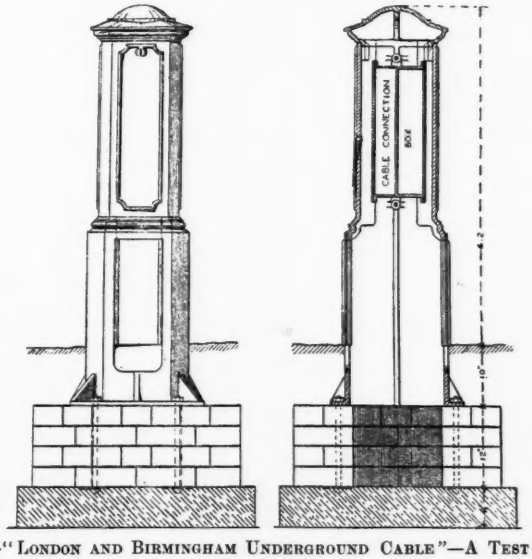


FIG. 2.—"LONDON AND BIRMINGHAM UNDERGROUND CABLE"—A TEST PILLAR.

winch at the other end of the 150 yards section of pipes.

The crab winch is anchored by the following means: A hole is dug on the line of pipes about three yards away from the pulling end, and the crab winch is lashed down by means of ropes to the pipes. As the cable enters the pipes, and while it is being drawn in it is liberally lubricated with petroleum jelly, and when the full length is drawn in the clip end is sawn off, and the ends of the cable, after being carefully sealed by means of a lead disk and solder, are then laid down in the trench and, after being carefully protected by pieces of timber, the ground is filled in.

As lodging accommodation can not be obtained in the villages for the whole of the men comprising the cable gang and jointers, the work is so arranged that the jointers are about five miles in rear of the cable gang, so that as the cable men vacate their lodgings the jointers are ready to occupy them.

A joint hole having been opened up, a sheet of iron is laced under the ends of the cables, a similar sheet is placed on each side against the earth, a tent is erected over the hole, and canvas sheets are suspended round the sides of the hole in order to make the opening as warm and dry as possible before exposing the core of the cable.

Owing to springs and running water it is frequently found necessary to dig a sump hole in the trench and keep a lift pump at work during the operation of jointing, and occasionally it is necessary to keep two such pumps at work at one hole.

A cast-iron slide pipe is now passed over the end pipe exposed in the hole and a lead sleeve over the end of the cable; the latter is then opened out to a convenient length and the jointing commenced. The wires are turned back and tied together in flakes, and the jointing commences with the bottom pair. The conductors are joined by means of a split copper tube, tinned inside and out; a paper sleeve is drawn over the joint, and the pairs of wires are tied lightly together with thread.

When the whole of the wires are jointed, they are tested for continuity, and proved to be in proper order, without crosses, and then the whole joint is thoroughly baked by means of charcoal braziers, in order to dry out any moisture. The presence of moisture is detected by means of a piece of silvered glass, which is placed over the joint, and which indicates the slightest trace of moisture while the cable is being baked.

As the jointing proceeds in all weathers, the time occupied in drying a joint varies from one to two hours, according to the amount of moisture in the atmosphere.

After the conductors are jointed, the lead sleeve is drawn over and fixed by means of a plumber's wiped joint A small vent-hole is left in the upper part of the lead sleeve, and as a final test for moisture, the silvered glass is placed over this hole, when, should the test be satisfactory, a lead cap is "wiped" on, and the joint is then complete. The iron slide pipe is now drawn over the cable joint, and this is yarned and leaded in the usual way.

At distances of five miles the cable is brought up to distribution boxes, fixed in test pillars, somewhat resembling a pillar letter box. In the boxes the wires are soldered to insulation pins, an iron partition divides the box through which the pins are fixed, the two ends of the cables are brought up the pillar to the pins at the back of the partition, and the wires are crossed over in front by means of short pieces of india-rubber-covered wire. The distribution boxes are furnished with iron covers, which are fixed by means of gun-metal set screws. These boxes are provided for the purpose of testing, also for pumping dry air through the cable, should the necessity for this arise in the future.

The route of the cable from the General Post Office is via Newgate street, Farringdon street, St. Pancras, Chalk Farm, Cricklewood, Hendon, Edgware, Stanmore, Watford, Hemel Hempstead, Leighton Buzzard, Fenny Stratford, Towcester, Weedon, Southam, Leamington, Warwick, Kingswood, Horkley Heath, thence via the Old Stratford Road to Birmingham Post Office, a distance of 116 miles.

The cable is completed as far as Fenny Stratford, a distance of 50 miles, and several telegraph circuits are working through this section. A further section from Fenny Stratford to Weedon, a distance of 23 miles, will be ready for working in the course of two or three weeks. The insulation of this section is 28,000 megohms per mile.

Up to date 94 miles of pipes have been laid, 74 miles of cable have been drawn into the pipes, 980 cable joints, and 75,000 wire joints have been made.—*London Electrical Review.*

The Electric Boat Company.

The Electric Boat Company, with a capital of $10,000,000, has been incorporated at Trenton, N. J. The company is empowered to build vessels of all kinds, to operate steamship lines or engage in any kind of manufacturing enterprises. The incorporators are: Charles Blizard, William H. Palmer, Jr., and Augustus Treadwell, Jr. All the incorporators are connected with the Electric Storage Battery Company, Mr. Blizard being the manager of the company's New York office.

Electrical Review

[OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES.]
TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2339. NEW YORK.

NEW YORK, FEBRUARY 15, 1899.

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TELEPHONE CALL, 1546 "CORTLANDT."

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News, Subscriptions and Advertisements.

SPECIAL NOTICE TO ADVERTISERS.
CHANGES for advertisements must be in this office by Friday noon for the following week's issue. NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

Subscription to the ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - 5.00
Single Copies, - - - - - - - - - - .10
Copies can only be supplied for one year back at 25 cents each.

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The death of Jesse H. Bunnell will be sad news to the electrical fraternity, particularly to the pioneer and war-time telegraph operators. His experience was interesting and unique. He was distinguished for courage and ability during the war of the rebellion in following his profession. His liberality, as success crowned his life, to old-time operators was proverbial, and they never were turned away from his office without kind words and substantial assistance.

Mr. W. J. Fransioli, former general manager of the Manhattan Elevated Railway, and now general manager of the Auto-Truck Company, of New York city, is reported in the New York *World* of June 20, 1897, as endorsing the Keely motor, after having critically examined it. The newspaper quotes Mr. Fransioli as saying "there does not exist one element of fraud or trickery in the experiment." We are inclined to believe that Mr. Fransioli read with much interest the recent exposé of the Keely methods by a committee of scientists in Philadelphia.

If rapid growth and diversity of successful application of the great electric generating plant at Niagara Falls are to be considered as indications, it will not be long till that locality will become one of the wonders of the world commercially, as it long has been physically.

The enormous store of energy has hardly been tapped, yet a large colony of manufacturing enterprises is already in full swing and many more are in contemplation. It would be but a natural consequence in time to see the Falls themselves almost disappear and this picturesque Mecca become "transformed" into one of the greatest hives of industry on the continent.

According to a cable dispatch to the New York *Sun* from Brussels, manufacturers of typesetting machines and hand compositors will have to bear in mind in the future the possibility of the running of a typeless newspaper. The compositors of the well known Brussels journal *Petit Bleu* had struck. The news, accompanying 16 pages of illustrations, was set on a typewriter. Then the single typewritten sheets and the pictures were pasted on sheets of cardboard larger than the size of the newspaper. Then the whole was reduced by photography to the actual size. A print was made from the negative on a sensitized sheet of zinc. With the aid of nitric acid type and illustrations were etched in, and the result was a complete, solid form ready for the press. It would be interesting to know the exact time occupied in the process.

The New York Telephone Company, with its usual foresight and regard for the convenience of its subscribers, took every precaution to prevent any delay or annoyance in the telephone service of New York city owing to the recent blizzard. In a technical sense, of course, every possible precaution was taken. The excellent underground system of the company naturally prevented any interruption of the service from the causes incident to blown-down wires. In addition, the company engaged rooms at hotels in the vicinity of its exchanges for the accommodation of its operators who might be delayed by the storm in getting to their work. The result was that the day after the storm the telephone business of New York city went on smoothly as usual. Such enterprise and forethought as that exhibited by the New York Telephone Company is in the highest degree commendable.

We note an elaborate editorial in the current *Street Railway Journal* on "A New General Formula for Train Resistance." We are glad to see such interest displayed in a difficult subject. But so long as a general formula of this character is not elastic enough to be fitted to the varying conditions always found in practice, it can not be more than approximately applied in the problems met by the railroad engineer. These technical formulas are most useful in text-book training and as a means of encouraging physical experiment. The dead-level track is almost a myth. It is up-grade or down-grade to some extent nearly everywhere; contours and drainage require it so. Joints become defective over night, and a hundred conditions constantly recur destructive of formulaic accuracy. Nevertheless the Lundie formula deserves the attention of all railroad engineers, and no doubt will be most favorably considered by them.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

The market closed the week comparatively dull and uninteresting, although over 400,000 shares of stock were dealt in to-day. The New York Stock Exchange will be closed to-morrow, Saturday, and Monday on account of Lincoln's birthday.

As compared with the closing prices of last Saturday, the majority of stocks close the week lower. The business outlook is still of the most encouraging character, and trade reports show great activity in industrial circles throughout the country.

On the New York Stock Exchange General Electric closed to-day at 110¾ bid and 111 asked, a decline of 1 point for the week. Edison Electric Illuminating of New York closed at 196½ bid and 197 asked, a gain of ½ point. Metropolitan Street Railway, of New York, closed at 234 bid and 234½ asked, a rise of 2¾ points for the week.

On the Boston exchange American Bell Telephone closed at 347 bid and 349 asked, a rise of 31 points for the week. The only explanation given for the record high prices at which this stock is selling is that it is being purchased by investors. There are no rumors of important changes in the company or its policy. Erie Telephone closed at 90 bid and no asked price, a rise of 1 point for the week.

On the Philadelphia Exchange Electric Storage Battery, common, closed at 101½ bid and 102 asked, a rise of 13½ points for the week and 23¾ points in two weeks. The remarkably prosperous outlook for the use of storage batteries is the reason assigned for the rapid advance of this stock. Electric Vehicle closed at no bid price and 45 asked, a rise of 17¼ points for the week.

A prominent Philadelphia banker is quoted as saying: "I hear very good things of Union Traction. I am informed that they are earning $1,000 a day over their earnings last year and are on the sure road to the payment of dividends in the near future. The great source of the strength of Union Traction, however, lies in its franchise rights, which are perpetual and very liberal. I am told that those in the company are buying the stock extensively."

Wall Street, February 10.

The New York *Press* describes the Crehore-Squier system of telegraphy as the "sign wave plan." Not so bad, is it?

PERSONAL.

Mr. Eugene F. Phillips, general manager of the American Electrical Works, Providence, R. I., was among last week's out-of-town visitors to New York city.

Mr. A. M. Young, president of the National Electric Light Association, returned to New York on Tuesday of this week, after a three weeks' absence in Europe.

Dr. Louis Duncan, the well known electrical engineer, and Mr. Manning K. Eyre, until recently general manager of the Edison Lamp Works, at Harrison, N. J., have formed a partnership as consulting engineers. The new firm has established itself in a handsome suite of offices in the Empire Building, at 71 Broadway, New York city. The ELECTRICAL REVIEW extends its best wishes for success.

Mr. Fred. W. Royce, the well known electrical engineer of Washington, D. C., is meeting with fine success in the raising of high-grade blooded chickens. This is rather a new departure for a technical man, but Mr. Royce recently became interested in the admirable work, "The Kansas Hen"—hence his hennery. An illustrated catalogue will be sent to parties interested who write Mr. Royce, enclosing two cents in postage.

Mr. James S. Anthony, formerly with the Walker Company, of Cleveland, Ohio, has accepted the position of eastern assistant director of machinery and electricity for the United States to the Paris Exposition, and will make his headquarters at 120 Broadway, New York. Mr. Anthony will be a valuable aid to the staff of Mr. F. E. Drake, director in charge of this department, and is not only experienced in electrical and mechanical work, but is well acquainted with the language of our French brethren. Mr. Drake will probably go to Paris this month for a brief inspection visit, Mr. Anthony remaining here in charge.

J. H. Bunnell & Company.

The ELECTRICAL REVIEW is informed that, notwithstanding the death of Mr. Jesse H. Bunnell, the electrical manufacturing and supply business of J. H. Bunnell & Company, 76 Cortlandt street, New York city, will be carried on as usual under the same firm name and at the same address.

Lehigh University.

The ELECTRICAL REVIEW has received the "Register of the Lehigh University, South Bethlehem, Pa., 1898–1899." It contains descriptive details of a commendable course in electrical engineering.

Electricity vs. Steam on the South Side Elevated Railroad, Chicago.

The ELECTRICAL REVIEW has received the following interesting figures regarding the comparative operation of the South Side Elevated Railroad, of Chicago, by steam and electricity. The figures are for the months of November and December, 1897 and 1898, the first strictly comparative months in the operation of the road:

The road, including "loop" operation, 19.44 miles of track, in 1897 was operated entirely by steam, and in 1898 entirely by the Sprague multiple unit electric system. In addition to all "loop" expenses there is a rental charge equal to 10 per cent on the gross passenger receipts of the road. This should be considered really as an interest charge, not as an operative expense. For these two months the comparative table following shows:

(*a*) Ratio of expenses to earnings, *including* "loop" rental, taxes and licenses;

(*b*) Ratio of expenses to earnings, *excluding* "loop" rental, but including taxes and licenses;

(*c*) Net earnings.

	(*a*)	(*b*)	(*c*)
November, '97, steam,	87.3	77.7	$10,603 80
" '98, electric,	57.3	47.7	39,448 56
December, '97, steam,	83.6	73.6	14,691 69
" '98, electric,	55.0	45.4	45,355 68

Rumor of Another Electric Light Deal in Greater New York.

A rumor was current last Saturday that plans were nearing completion for the sale of the stock of the Kings County Electric Light and Power Company, of Brooklyn, N. Y., to the New York Gas and Electric Light, Heat and Power Company. The last named company is the $25,000,000 company organized by William C. Whitney and his friends, which has already absorbed most of the electric lighting companies of the borough of Manhattan.

It is said that the plans contemplate an exchange of stock on the basis of about two shares of preferred stock of the New York company for one share of stock of the Kings County company. The stock of the New York company, it is said, will be underwritten by local bankers at 90. Kings County stock has been selling around 150.

Telephone Supplies Wanted.

The ELECTRICAL REVIEW is informed that Mr. R. J. Collins, of Hattiesburg, Miss., has bought the Hattiesburg Telephone Exchange, and is now in the market for a quantity of wire, insulators, batteries, etc., as he expects to enlarge the plant and run lines to the neighboring towns and villages.

American Street Railway Association.

The eighteenth annual meeting of the American Street Railway Association and third annual meeting of the Street Railway Accountants' Association of America will be held in Chicago October 17, 18, 19 and 20, 1899, at "Tattersall's," State and Sixteenth streets.

President Charles S. Sergeant, secretary and treasurer T. C. Penington, Walton H. Holmes, of Kansas City; Albion E. Long, of Toledo; George A. Yuille, of Chicago; Frank G. Jones, of Memphis; John I. Beggs, of Milwaukee, and Ira A. McCormack, of New York, members of the executive committee of the American Street Railway Association, met in Chicago on February 6 and 7, and completed all the preliminary arrangements for the convention. The hall is well suited to the purpose of the exhibit, having a clear floor space, without columns, of 50,000 square feet. The meeting rooms of both associations will be under the same roof, with ample retiring and committee rooms. The last day of the convention will be set apart for the systematic and careful inspection of the exhibits by the delegates, a fact which will be appreciated by all exhibitors. The banquet will be given on the night of the last day, at which the installation of the newly-elected officers will take place. The committee resolved to make unusual efforts to secure the attendance of representatives of the mechanical, operating and auditing departments, which will make the convention of great practical value to those departments. Heretofore the attendance of delegates has been largely confined to the administrative departments.

The hall will be well heated and lighted, the light during the hours of the day leaving nothing to be desired. All the exhibits will be on the same floor, and there will be little choice as to location. All electric power necessary will be furnished.

The following subjects were selected upon which papers should be read: "Maintenance of Car Equipment," "The Modern Street Railway Shop: Its Design, Machinery and Shop Practice," "Train Service and Its Practical Application," "Investments in Street Railways: How Can They Be Made Secure and Remunerative?" "Construction and Maintenance of Railway Track."

The headquarters of the association will be at the Auditorium Hotel and Auditorium Annex. During the visit of the committee the local companies showed them every courtesy, and between business and pleasure there were few moments unoccupied. The committee were entertained at the Union League Club, where a dinner was given by Mr. John M. Roach, of the North Chicago Street Railroad Company. The party afterwards attended the theater.

OBITUARY.

Hugh L. Childress, superintendent of the southern division of the Postal Telegraph-Cable Company, with headquarters in Birmingham, Ala., died on February 4 at the Southern Hotel in Chattanooga, Tenn., after a lingering illness from cerebro-meningitis. Mr. Childress was only 30 years of age, and was one of the youngest division superintendents in the United States.

American Institute of Electrical Engineers.

The 132d meeting of the institute will be held at 12 West Thirty-first street, New York city, on Wednesday, February 15, 1899, at 8 o'clock P. M. A paper will be presented by Robert McA. Lloyd, of New York city, on "Storage Batteries and Railway Power Stations."

On the same evening, February 15, a meeting of western members will be held in the rooms of the Technical Club, 228 South Clark street, Chicago. The author will be represented at Chicago by Mr. B. J. Arnold.

The new catalogue of members of the American Institute of Electrical Engineers, revised to February 1, 1899, has just been issued. It shows a total membership of 1,122, divided as follows: Honorary members, 2; members, 364; associate members, 756.

International Society of Electricians, of France.

The ELECTRICAL REVIEW is informed that if any one in this country desires to join the International Society of Electricians, of France, he may communicate with Prof. Carl Hering, 929 Chestnut street, Philadelphia, as the American representative of the society. The dues are only 20 francs ($4) per year, which includes the monthly *Bulletin*. The American electricians who intend to visit the Paris Exposition next year will find it greatly to their advantage to be members of this society. Such membership includes the use of the society's rooms in Paris, where there is also a good electrical laboratory. The address of the society is 13 and 14 Rue de Stael, Paris. Besides the American members mentioned in the ELECTRICAL REVIEW last week there are also Messrs. Nikola Tesla, Geo. A. Hamilton, Stephen Emmens and R. M. Hunter.

Steel for Permanent Magnets.

[*From the London Electrical Review.*]

Among recent contributions to our knowledge of iron and steel, the most important is Madame Sklodowska Curie's account of her investigation of the properties of various kinds of steel, with a view to their use for making permanent magnets. This was published last January in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*. Madame Curie has experimented with some 47 different kinds of steel, including a series of ordinary carbon steels having different percentages of carbon, and a number of others containing special constituents — chromium, copper, nickel, manganese, tungsten and molybdenum. She gives, in her paper, a complete chemical analysis of all the different steels employed, a table showing the temperatures of magnetic transformation in every case, a table of the usual magnetic properties; viz., the residual magnetization and the coercivity, tables of the results of experiments on long continued heating, of repeated blows, and of partial demagnetization, with much other information and comment. A mode of aging a magnet after manufacture is described, which the authoress found to reduce the subsequent variations of intensity to very small amounts. We take this opportunity of complimenting Madame Curie on her patient and systematic work. It does not appear that she made any new departure, or any particular discovery, and her methods are such as most of us are familiar with; but her information is more extensive, varied and exact than anything we have previously seen on this subject. It is probable that makers of instruments in which permanent magnets are used have discovered rules for treating magnets similar or equivalent to those proposed by Madame Curie, but they have not made them public property.

The authoress dwells strongly on the identity between the temperature at which steel changes from the magnetic to the non-magnetic state, or vice versa, and that at which steel can be hardened by sudden chill. The fact is now well recognized that the point of recalescence is critical alike for the magnetic and mechanical transformation. She has studied the difference of the transformation point on rising and falling temperatures, but in none of her specimens did this difference approach the amount found by Dr. Hopkinson for certain nickel steels.

In the early part of her paper, Madame Curie discusses carefully the use and interpretation of the cyclic diagram, and points out the uncertainty of its meaning, if used as a guide to the quality of the material, when obtained from a bar or other open magnetic circuit. None of the results of tests on bars are given in diagrams, the residual intensity and coercivity being merely tabulated, and the figures of the intensities for bars of the same dimensions, which alone are comparable, are put in the same column. In the case of steels tested as rings, the cyclic diagrams are given as well as the numerical results. Now, although the cyclic diagram of an open circuited magnet is not to be interpreted without reference to the exact form of the magnet, it is still, from one point of view, desirable to have it. In a cyclic diagram the point where the curve cuts the vertical or B axis represents the normal condition of the magnet after manufacture, and the properties of the finished magnet are represented by the character of the curve at that point. The change in the magnetization, due to a small reverse field, will be determined by the slope of the curve at that point, and, if the curve is nearly horizontal, the steel will be magnetically very rigid. The measure of the magnetic rigidity is the intercept on the H axis of the tangent to the curve at its intersection with the B axis and not the intercept on the H axis of the curve itself. This latter intercept, the coercivity, has no necessary connection with the magnetic rigidity in the ordinary magnetized condition, though these cyclic curves are so similar in form that the value of the coercivity is a fair indication of the rigidity; or, in other words, the two intercepts may be nearly proportional to one another for all steels. It is, however, quite conceivable that a steel might be found having small coercivity and great rigidity, in which case the upper limb of the cyclic curve would be nearly horizontal on the B axis and drop sharply at a small distance to the left of it. In this case its coercivity would be a misleading indication of the value of the steel.

The percentage difference between the magnetization in a strong and a zero field might be a more useful criterion than the coercivity, and this quantity is calculated in some Reichsanstalt reports to which we refer later. The most complete information would be given by a small cycle in the immediate neighborhood of the intersection of the B axis between points given by magnetizing fields of, say, + 5 and − 5. The increased stability of partially demagnetized magnets should be indicated by this small cycle being very near horizontal in both limbs. We could wish that Madame Curie had determined this small cycle for one of her finished and aged bars and so demonstrated the nature of its extreme rigidity.

As a general result of her investigation, Madame Curie finds three kinds of steel specially suitable for magnets. She confirms the high character of the well known Allevard steel, which contains .59 per cent carbon and 5.5 per cent tungsten, but finds that a steel containing 1.7 per cent carbon and four per cent molybdenum instead of tungsten possesses still higher qualities. This molybdenum steel which came from the firm of Chatillon et Commentry was not then in commercial use. None of the steels examined came from an English foundry, but we have lately seen a Reichsanstalt report on an English tungsten steel, that of Messrs. J. J. Saville & Company, to which we may refer here for comparison. This steel has a coercivity 65, as compared with 74 for Allevard steel, and 85 for molybdenum steel. The residual magnetizations of the different specimens are not comparable, as the forms of the magnetic circuits were different.

Besides these steels, which do not differ greatly from one another, Madame Curie examined a steel called Boreas, made by Boehler, of Styria, which has a high coercivity 85. It has properties very different from the others, having a much lower residual intensity and suggests a possibility of still greater variations in magnetic properties with different chemical constitution. It is evident from Madame Curie's paper that one of the most important points in the construction of magnets is a careful regulation of the hardening temperature, which should not exceed a certain moderate limit. This is somewhat curious, since the steel in manufacture must have been exposed to much higher and less well regulated temperatures than Madame Curie found afterwards to be injurious, and suggests that investigations on these steels should be carried out at a stage of manufacture earlier than that at which they reached her hands. It would seem, moreover, from the close connection that exists between the magnetic and mechanical changes that take place at the transformation point that a careful regulation of the hardening temperature should be as important for the mechanical as it is for the magnetic properties of steel. Though manufacturers of springs and cutting tools, as well as metallurgical laboratories, employ refined modes of hardening and tempering steel, the ordinary practice of workshops is extremely rough and ready. One is commonly told that individual toolsmiths possess great knowledge of and skill in manipulating their material, but in many shops every workman is expected to be able to make his own tools, particularly such small tools as drills and screwdrivers, and the results are often unsatisfactory and expensive. It would seem that a steel-hardening furnace, with a thermo-couple and galvanometer, should be part of the equipment of every good mechanical workshop, and that the properties of steel and iron should form as essential a part of the technical training of a mechanic as a course of machine drawing or geometry. Burning a steel cutter that has cost £2 or £3 to machine, or making one waster in every three magnets hardened, would then be unpardonable. Nothing seems more certain than that, if the English workman is shown, when young, better methods and more refined conceptions in mechanical practice, the standard of the workshops will rise. The technical education of the older apprentice and the young journeyman, not of the schoolboy, would be the salvation of the English workshops. No one more than the writer respects the English workman's love of good work for its own sake; no one more greatly deplores his ignorance. Every piece of accurate research provides a new text for a discourse on the necessity of technical education for the workman, and no outlay can be more remunerative; only it must be for the workman who knows what work is: not for the overgrown schoolboy. Mechanical engineering is as much the child of the singular properties of steel at its recalescent point, its capacity for being hardened and tempered, as chemistry is of the properties of glass, and no subject is better worth the attention of mechanical engineers and of their employés.

ELECTRIC RAILWAY NOTES.

The Easton, Pa., Palmer & Bethlehem Street Railway Company has placed a mortgage for $200,000 with the United States Mortgage and Trust Company, of New York.

At a meeting of the board of directors of the Tiffin, Ohio, Fostoria & Eastern Electric Railroad, D. H. Kimberly, of Cleveland, was elected president; W. H. Gabriel, vice-president; C. C. Everets, secretary, and S. B. Sneath, treasurer.

At a meeting of the stockholders of the Schenectady, N. Y., Street Railway Company, the following were elected directors: J. P. Ord, E. W. Rice, S. D. Greene, John Kruesi, F. O. Blackwell, J. R. Lovejoy, Theo. Stebbins, H. C. White and J. G. Barry.

The directors of the Mystic Valley, Mass., and the Salem & Wakefield Street Railway companies have organized for the current corporate year as follows: President, Charles F. Woodward; vice-president, James F. Shaw; treasurer and clerk, George A. Butman; directors, Cyrus G. Beebe, Junius Beebe, E. M. Southworth, John G. Aborn, James F. Emerson.

The quarterly report of the Penn Yan, Keuka Park & Branchport Electric Railroad for the quarter ended December 31, 1898, is as follows: Gross earnings from operations, $6,465.40; operating expenses, $5,008.29; net earnings from operations, $1,457.11; fixed charges, $1,536 84; net deficit, $79 73. The general balance sheet shows assets of $204,685.17; including $200,000 for cost of the road and equipment; $4,685.17 cash on hand. The liabilities include $90,000 capital stock; $2,601.84 surplus.

Telephone News .....and Comment

The subscription for the Erie Telegraph and Telephone five per cent bonds, amounting to $2,000,000, aggregated $4,300,000.

Miss Nellie Maxwell and Albert Ranz, of Williamsport, Pa., were recently married by telephone, the groom being at the time in Elmira, N. Y.

The Standard Telephone Company, of Waukon, Iowa, has filed amended articles of incorporation with the Secretary of State, increasing the capital stock to $50,000.

The annual report of the Bell Telephone Company, of Buffalo, shows: Capital stock, $2,000,000, of which $,000,000 has been paid in; the debts do not exceed $110,000, and the assets are at least $125,000.

The board of directors of the Independent Telephone Company, of Mt. Joy, Pa., organized as follows: President, Israel G. Erb; vice-president, P. S. Erb; secretary, H. Reist Landis, and treasurer, W. M. Amer.

The Erie Telephone and Telegraph Company's directors have declared a regular quarterly dividend of one per cent, payable February 20, to stock of record at noon February 11. Books closed February 11, and reopen February 20.

Lucy M. Harrison has filed a suit for $10,000 damages against the Southern Bell Telephone Company of Atlanta, Ga. She alleges that she became entangled in some wire on Elliott street belonging to the company and received a severe fall.

The Chicago Telephone Company, to meet the threatened competition of the proposed new Illinois Telephone and Telegraph Company, has petitioned for an extension of its franchises for 20 years and offers in return to largely reduce tariffs and make larger compensation to the city.

People who should be in a position to know of any important change in American Bell Telephone Company's affairs say they can not account for the advance in the price of the stock to 330. A very large stockholder says: "I imagine it is simply investment buying. At 333 the stock pays about four and one-half per cent."

At the annual meeting of the Southern New England Telephone Company, New Haven, Ct., the following directors were elected: Morris F. Tyler, James English, William E. Downes, Samuel E. Merwin, Lyman B. Jewell, A. Heaton Robertson, Thomas Sherwin, John W. Alling, John E. Hudson.

President Michael C. Murphy, of the New York Board of Health, has ordered 10 of his inspectors to begin an examination of public telephones of New York city in districts where the telephone service is busiest. Colonel Murphy believes that the telephone transmitters are a means of spreading contagious diseases. His belief, he says, is founded on a recent investigation conducted in Europe.

The Interstate Telephone Company, of Cleveland, Ohio, has been organized with $25,000 capital. The officers of the company are: President, F. T. Pomeroy; vice-president, Scott R. Hayes; secretary, C. B. Arthur; treasurer, C. F. Moore, and general manager, A. W. Warner. The directors are H. A. Everett, Scott R. Hayes, J. A. Rutherford, C. H. North, R. M. Fuller, A. W. Warner and F. T. Pomeroy. The new company will have its headquarters in Cleveland.

The Commissioners of the District of Columbia, to whom the bill to incorporate the Columbia Telephone Company, of Washington, D. C., was referred, have made an adverse report thereon. They say that the telephone service can be better rendered by a single company, under proper management and at proper rates, than by two or more companies having separate lines and instruments. This leaves the local Bell company, the Chesapeake & Potomac Telephone Company, in control.

A telephone company in an Iowa town has made an interesting discovery and at the same time solved a mystery which has been puzzling it for weeks. The telephone lines, which had previously given good service, began a short time ago to develop all sorts of queer symptoms, the induction in some cases being so strong that a person using a receiver could hear half a dozen different people talking at once. The linemen had a bad time searching up and down the wires for the trouble. At length they found a spot where a heavy lead cable had received a shot from a 22-caliber rifle. The bullet had twisted and cut the wires and worked several varieties of damage. The injured section of the cable had to be cut out and spliced.

The Middleburgh & Oak Hill, N. Y., Telephone Company, at its annual meeting, elected the following officers: President, Elias M. Dutton, of Middleburgh; vice-president, George Rugg, of Franklinton; secretary, George M. Hallenbeck, of Preston Hollow; treasurer, Wesley P. Elsbree, of Preston Hollow. The directors are Dr. George Conklin, of Durham; Emerson Ford, of Oak Hill; G. F. White, A. S. Coons, G. M. Hallenbeck, of Preston Hollow; A. Grayman, William Chase, of Livingstonville; George Graham and A. Graham, of Franklinton; W. E. Bassler, Elias W. Dutton, of Middleburgh.

The Compressed Air Boom.

[*From the American Machinist.*]

We have been, as we could not have failed to have been, believers in the adaptability and efficiency of compressed air for certain purposes of power storage and transmission. We have been glad to do what we could to spread information concerning it for the purposes for which it is eminently adapted. We have never believed and never represented that compressed air is the best means of power transmission in existence, or that it can ever supplant other means, except in the somewhat limited field which especially belongs to it. In shop use, with which we have most to do, it has shown its great value, especially for direct hoisting and for the driving of small portable tools, just as it had previously done in mining, tunneling and submarine work. The field of its usefulness has latterly broadened, until the number of its occupations is legion. A couple of street cars were run for a year upon one of the surface railway lines of this city and gave a most creditable exhibition. A fine power-station and a full equipment of compressed-air cars for one of the cross-town lines of the city are now being prepared, and will soon, we hope, be in successful and permanent operation. The air-compressing plant will be much superior to that previously employed, and the motors also will exhibit the beneficial effects of the previously acquired experience, so that the present most strongly entrenched electric systems may not, after all, be the only means of surface traction.

But we are promised an exhibition of the powers of compressed air far more pretentious than this. It is proposing to arise in its might and drive practically all the horses from our streets. The autotruck is to transform the city. We have a great boom on for compressed air. There is an American Air Power Company, with a capital of $7,000,000; an International Air Power Company, with a capital also of $7,000,000; a New York Autotruck Company, $10,000,000, and a Chicago Autotruck Company, $10,000,000. Such eminent engineers as Richard Croker and Joseph Leiter are operating the machinery, stock is selling, and its "value" is advancing. Some of it has been quoted above 70; but where is the truck, and what can it do? Where is the first truck, and where is there any promising record of its practical performance? There is a truck which has hauled castings around a factory yard in Worcester, Mass., and that, we are given to understand, is all that there is as yet to show. Two factories are ready to rush out the trucks, but are they yet invented? We are not here implying that they are not; but the question would seem to be a proper one. When stock is for sale the stock buyers should know what they are buying. Do they know in the present case?

ELECTRIC LIGHT FLASHES.

The plant of the Tehama, Cal., Electric Company, owned and operated by James Cross, of San Francisco, has been destroyed by fire. The plant had been but recently completed at a cost of between $20,000 and $30,000. The plant will be rebuilt.

The plant of the Iowa City, Iowa, Electric Light Company, situated at Centerville, three miles north of the city, was entirely destroyed by fire a few days ago. The fire is supposed to have started from the chimney. Loss from $15,000 to $20,000; insurance, $13,000. The plant was both arc and incandescent and furnished all the lights for the city.

At the annual meeting of the stockholders of the Somerville, Mass., Electric Light Company, the following board of directors was elected: David Cummings, Louis E. Merry, H. H. Moore, W. L. Hooper, G. B. Neal, E. L. Churchill, J. H. Flitner, G. M. Starbird and E. S Sparrow. F. Elwood Smith was elected secretary and treasurer.

National Association of Municipal Electricians.

A meeting of the executive committee of the Fire and Police Telegraph Superintendents' Association was held in Boston on January 28, at the offices of the wire department in the old court house, which were placed at the disposal of the committee by Commissioner Thomas W. Flood. Every member of the committee was present, and much business of importance concerning the future of the association was transacted. The object of the meeting was to revise and amend the constitution and by-laws in accordance with the resolution passed at the third annual convention at Elmira, and to outline the arrangements for the next annual meeting, which takes place at Wilmington, Del., September 5–6; also to suggest topics for papers to be presented at that meeting. The members of the executive committee are John W. Aydon, president of the association; W. Y. Ellett, of Elmira, chairman; F. C. Mason, Brooklyn; W. H. Thompson, Richmond; Morris W. Mead, Pittsburgh; Capt. William Brophy, Boston; Clarence E. Stump, New York, as secretary pro tem.

In order to broaden the field of work in which the association is engaged, it was decided to change the name from the "International Association of Fire and Police Telegraph Superintendents" to the "National Association of Municipal Electricians," which title renders eligible for membership all officials engaged in the electrical departments of municipalities throughout America, instead of only those engaged in the fire, police and telegraph departments as heretofore. The associate members are composed of manufacturers and dealers in apparatus and appliances relating to the interests kindred to the association. The following are the titles of some of the important papers that will be read at the next annual convention:

"The Laws and Government of the Wire Department of Boston," Commissioner Thomas W. Flood. This is the first time that Commissioner Flood has consented to personally review the very important work carried on by his department, and as Boston is the only city that has such a department, it will no doubt greatly interest and instruct not only the municipal electricians throughout the country, but the electrical public as well.

"Licensing of Employés Engaged in Electrical Work and the Improvement of the Quality of Work and Material," Capt. William Brophy, of Boston.

"Advisability of Concentrating the Control of All Municipal Electrical Interests under One Head," Morris W. Mead, of Pittsburgh.

"The Underground System as Applied to the Fire Alarm Telegraph," S. L. Wheeler, city electrician, Springfield, Mass.

"The Police Signal System of Boston," John Weigel, superintendent police telegraph, Boston.

"Aerial Construction of Fire and Police Telegraph lines," W. H. Thompson, city electrician, Richmond, Va.

"Progress and Development of the Municipal Electrical Interests of Canada," G. F. MacDonald, Ottawa, Can.

In connection with the next meeting of the association will be held an exhibition of electrical and mechanical apparatus used in various departments of municipal work, which will be of a very interesting and instructive character. A large building, well adapted for this purpose, has been secured, and every facility will be afforded manufacturers to attractively display their goods. Ample power will be supplied for operative exhibits, and a special committee will be appointed by the association to make report on the exhibits.

The Board of Trade of the city of Wilmington has taken an active interest in this feature of the meeting, and has already appointed a committee from that body to assist in making the exhibition a successful one. The railroads have agreed to make special freight rates to exhibitors.

Among the displays will be one showing the various stages of progress in the municipal fire-alarm business down to the present date. The first box ever used to call out a fire department will be on exhibition, and such other boxes as the state of the art evolved along progressive lines. The Montauk Multiphase Cable Company will make an exhibition of their cable in connection with all interior adaptations. Telephones, district call boxes, watchman's time detector service, electric lights and Gamewell auxiliary fire-alarm boxes in circuit therewith, will be exhibited. The various insulating wire companies will make a display of their products, and there will also be added to the exhibition some special entertainment features.

After the work of the executive committee was completed, a visit was made to the works of the Gamewell Fire Alarm Telegraph Company, at Upper Falls, under the guidance of Mr. W. E. Decrow, the representative of the Gamewell company in Boston. Upon returning to the city, the party was conducted through the magnificent new terminal station by Capt. John Sanborn, the general manager; G. B. Francis, the resident engineer; Treasurer Coon and Electrician Caldwell. Much interest was manifested by all in this great work, and the electrical features connected therewith, it being the most complete and largest railway station in the world.

Capt. B. S. Flanders, superintendent of fire telegraph, and Mr. John Weigel, superintendent of police telegraph, conducted the visitors through their respective departments, and the party then adjourned to "The Hayward," where a most agreeable surprise in the form of an elaborate banquet awaited them. It was late in the evening before Toastmaster Brophy had secured a speech from all present, and the occasion will be long remembered by all who were so fortunate as to be present.

The following are the names of those who attended the meeting and subsequent entertainments:

William Brophy, chief electrician wire department, Boston, Mass; F. C. Mason, superintendent police telegraph, Brooklyn, N. Y.; Morris W. Mead, superintendent bureau of electricity, department of public safety, Pittsburgh, Pa.; C. W. Price, Montauk Multiphase Cable Company, New York, N. Y.; Walter G. Faulkner, Lynn, Mass.; B. S. Flanders, superintendent fire telegraph, Boston, Mass.; F. M. Ferrin, Boston, Mass.; Thomas W. Flood, commissioner of wires, Boston, Mass.; John Weigel, superintendent police telegraph, Boston, Mass.; H. F. Cottle, consulting electrician, Boston, Mass.; W. E. Decrow, Gamewell Fire Alarm Telegraph Company, Boston, Mass.; S. L. Wheeler, city electrician, Springfield, Mass.; Clarence E. Stump, City Government Publishing Company, New York, N. Y.; John W. Aydon, superintendent fire telegraph, Wilmington, Del.; W. Y. Ellett, superintendent fire telegraph, Elmira, N. Y.; W. H. Thompson, superintendent fire telegraph, Richmond, Va.; J. S. Wilson, American Circular Loom Company, Boston, Mass., and C. O. Baker, New York, N. Y.

New Telephone Exchange at Springfield, Mass.

The New England Telephone and Telegraph Company opened its new exchange at Springfield, Mass., on February 9, with a public reception. The exchange is located in a building which has been thoroughly remodeled to meet the requirements of the telephone company. An extensive power plant, consisting of storage batteries, together with electric motors, gas engine and dynamos for charging the batteries, is located in the basement. There, also, is the large switchboard for handling the power plant, and the ammeters, voltmeters, etc., necessary for its operation, the installation having the appearance to the visitor of a moderate-sized electric light station. The sound-proof booths for the use of the public and the manager's office are located in the office on the street floor. This is finished throughout in quartered oak, which makes a handsome setting for the oak booths. On the second floor are located the offices of the division superintendent, whose headquarters are in Springfield. On this floor is also the operators' retiring room, with their individual lockers and a conveniently-arranged toilet-room adjoining. One-half of the third or top floor of the building is entirely occupied by the operating room of the New England Telephone and Telegraph Company. In the other half of the third floor is located the American Telephone and Telegraph Company's long distance operating room.

The New England company's operating room is 87 by 20 feet, and is equipped with a new multiple relay switchboard of the latest pattern, provision being made to accommodate a growth four times the size of the present exchange. The central office apparatus embraces a number of novel features, and nothing has been spared in the arrangement of the building and the equipment of the office to make the new exchange a model one in every respect. The exchange was installed under the supervision of Mr. I. H. Farnham, electrical engineer of the New England Telephone and Telegraph Company.

Springfield had its first piece of underground cable laid in 1890, and this cable was used to take the wires under the Main-street arch of the raised grade for the new railroad station. From this small beginning the underground work has constantly increased to the present time, when there are over 11 miles of underground cable, containing 893 miles of telephone wire, under the streets. A large increase of the underground system is laid out for this year's work. The Springfield exchange is now the fourth largest in the territory of the New England Telephone and Telegraph Company, being exceeded in size only by two Boston and the Worcester exchanges, and has 1,361 subscribers, all but 72 of whom have taken advantage of the full benefit of the improved service by adopting the metallic-circuit service.

SOME KITE EXPERIMENTS.

ABSTRACT OF AN ARTICLE IN THE "MONTHLY WEATHER REVIEW," BY WILLIAM A. EDDY.

As to experiments on atmospheric electricity with kites, my first spark was drawn from copper wire, festooned to the kite cable, at Bayonne, N. J., October 8, 1892, followed by a large number of spark observations since that date. I found by measurement that the altitude of the collector when the first spark was drawn was closely related to the humidity of the air, and I drew curves showing the altitude of the collector as related to surface humidity at the earth, using wet and dry bulb thermometers with the Weather Bureau tables. In dry air I had to send the collector to a height of at least 600 feet before an appreciable spark resulted. The electric action can be traced with considerable certainty, because the frequency of the spark as related to the spark gap exactly corresponds to the electric intensity aloft. There is a relation between this spark frequency and the approach of clouds and local storms, especially as related to the formation of rain, which I hope to discover before long. My first indoor electric spark or flash of light through an incandescent globe from the kite wire occurred at 6.42 P.M., November 27, 1896. The spark was strengthened by two Leyden jars and by glass cylinders coated with tin foil, and by insulated coils of wire wound around soft iron. McAdie lighted an incandescent globe during a thunder-storm by kite wire in 1885 or 1892 at Blue Hill Observatory, but mine differed in that the carbon filament of the incandescent globe was broken before trial, on purpose, causing the kite wire spark to leap across a space in the vacuum.

On November 1, 1898, under a clear sky, I sent an electric collector into the air within about 100 feet of the Statue of Liberty, New York Harbor. The first spark was drawn at 11.15 A.M. with the collector about 200 feet above the surface of Liberty Island, and about 100 feet below the top of the torch of the statue. When I carried the kite wire, supported by three paper kites six feet in diameter, to within about 30 feet of the statue, an immense mass of bronze, the electric action vanished. Other experiments on November 1, 3 and 4, proved that the statue did not appreciably affect the air in this respect beyond a distance of 100 feet from its surface. Upon carrying the wire within 70 feet the electric action almost ceased. I hope to define more closely this electric influence later by triangulating distances and timing the sparks.

On August 4, 1894, I used several of my kites to raise a meteorograph at Blue Hill Observatory. A Richard thermograph, giving also barometric pressure, had been remodeled by Fergusson at the expense of the observatory, and was lighted by use of aluminum. Messrs. Clayton and Fergusson gave me every possible assistance. Mr. Rotch was then in Europe, but Mr. Clayton had previously granted me permission to try the first kite meteorological experiments there, which were conducted entirely at my own expense. This meteorograph, the first one in the world ever lifted by kites, reached a height of 1,400 feet, and it brought back to the earth, at times, an admirably clear record.

The Fergusson meteorograph just alluded to had carried out my suggestion of January 2, 1894, as published on page 483, Vol. X, of the *American Meteorological Journal*, entitled, "Weather map data at the height of 5,000 feet," in which I say:

It is clear that light meteorological instruments can be raised to a height of 5,000 feet by means of improved, tailless Malay kites . . . An aneroid barometer, a U-shaped Hicks thermometer and an anemometer, all self recording, can be so made that their combined weight shall not exceed one pound.*

I brought my kites to the Blue Hill Observatory, and the meteorograph was ready for use shortly after my arrival, when I at once made the ascension of August 4 described in the previous paragraph.

The first kite telephone message, as pointed out by Fergusson in *Monthly Weather Review*, August, 1898, page 366, with the kite wire extending over houses and trees, was successfully received by me at Bayonne, N. J, on December 5, 1896, the voices being heard clearly. Mr. H. C. Bradley, of the Lighthouse Service, near Boston, had suggested to me at Blue Hill Observatory in 1894, the possibility of listening to the sounds of the upper air by means of a telephone sent aloft. This would be of use in studying the audibility of fog signals. I tried this experiment late in December, 1896, but I could not hear, owing to a defective megaphone receiver and the roar of the wind against both the megaphone and kite cable, but I have improvements under way which may enable me to succeed soon.

My first rain kite reached a height of 591 feet on November 4, 1893, and remained aloft from 2 to 5 P. M., while the wind velocity at the New York Weather Bureau station was from 18 to 20 miles per hour. On August 18, 1896, a self-recording thermometer aloft passed through a heavy shower at Portland, Me., the kites remaining aloft, and subsequently drying in the air. The fall of temperature was from 71 degrees to 61 degrees.

My first aerial camera obscura, which I named the vistascope, ascended to a height of about 300 feet on the kite cable on August 15, 1897, when the sails of moving yachts and the roofs and sides of distant houses were visible to those lying on the ground and looking upward with a powerful field glass into the dark cavity of the camera obscura. On November 12, 1897, my first crossbow aeroplane was shot from the kite cable aloft, landing more than 1,000 feet away. It was fired at night, but a burning saltpeter fuse, attached to the arrowhead, traced its path in the darkness.

My first use of kites of specific size with which to measure the wind velocity by means of a pull on a spring balance as compared with a record of the anemometer at a similar height at the New York Weather Bureau station was made early in 1894, but was elaborated with many classified observations on December 18, 1897.

My first self-illumined, single-plane kite ascended March 26, 1898, with the lighted lantern within six inches of the surface of the kite. My first simultaneous kite temperatures were taken at New York and Bayonne, N. J., April 9, 1898. Mr. Henry L. Allen operated the kites at Bayonne and I operated those in New York. (See *Monthly Weather Review*, April, 1898, page 161.) The United States flag was first brilliantly illuminated by colored fire, also suspended in mid-air near the flag on April 30, 1898. My first dynamite messenger war kite ascended under wind pressure on April 2, 1898, and the first shooting-star war-signal lantern was released at a height of about 900 feet, and descended by gravity down the kite cable at 8 P. M., June 17, 1898.

Prof. S. P. Langley, in March or April, 1894, sent me a grant from the Hodgkins fund for the purpose of experiment with silk cord in reaching a great altitude with kites. My experiments with silk cord, which extended over more than a year, demonstrated that while silk was very strong for its weight, about twice as strong for its weight as compared with steel, as demonstrated by Professor Thurston, of Cornell University, yet its tensile strength was too unequal owing to fraying or attrition of its surface, and in my report to the Smithsonian Institution I recommended the use of flax with a steam engine for winding in the kite cable. The steam engine at Blue Hill Observatory was established by cooperation with the Hodgkins fund, steel wire being used, that standing next to silk in tensile strength, as related to its weight. Steel wire was used as kite cable by Archibald in 1884, as described in *Nature* in 1886.

Since about five miles of wire were run out at Blue Hill Observatory to reach 11,494 feet above the summit of the hill on August 26, 1898, with 149 square feet of kite surface, it seems to me that at great heights the increasing wind velocity with height may not quite compensate for loss of pressure due to rarefaction of the air. Important estimates remain to be made in this direction.

On July 28, 1898, by telegraphic orders from Gen. A. W. Greeley, I sent 26 of my kites and other apparatus to Newport News, Va., to demonstrate in Porto Rico, experimentally, the value of kites for photographing the enemy's fortifications. The report of Col. W. A. Glassford, who has charge of the apparatus, has not yet reached me. I have, however, heard indirectly, that my kites have been successfully used for military flag signaling in Porto Rico.

* In 1893, at the Columbian Exposition, I found that the title "Malay" was incorrect as applied to my form of kite, but I did not try to correct this usage until several years later.

The United Correspondence Schools

The United Correspondence Schools, 154-158 Fifth avenue, New York city, have issued a handsome and interesting booklet describing in detail their schools of engineering, schools of art and architecture and schools of trades, in all of which instruction is carried on by mail. The courses in the schools of engineering include electrical, mechanical, steam, civil and sanitary engineering. The booklet describes the methods in vogue in the schools and contains sample pages of instruction sheets. Any one interested in correspondence study may obtain a copy of the book on application.

Electric Light Apparatus Wanted.

A new electric lighting company has been formed in Lonaconing, Md., and is ready to negotiate with contractors for a plant and accessories. Address Howe Electric Light Company, Lonaconing, Md.

Platinum in the Yukon.

United States Consul McCook writes from Dawson City, December 5, 1898: Platinum has been recently discovered in the black sand which is found in great quantities in most of the creeks here; and, if the result is as good as is reported in the following clipping from a local paper, the Yukon district will have a new product of value:

The following account of the analysis of common-looking and supposedly worthless black sand will prove of great interest to all who have the future of this country at heart. Black sand is found in almost every stream in the Yukon territory, and, while considered a good indication of gold in more or less quantity, is always a nuisance to washers. On account of its great specific gravity, it remains in the sluice boxes with the gold, and even hand panning will not always separate it from the precious metal it accompanies. During the clean-up, many tons of this sand are thrown out, yet the analysis of 12 pounds of it taken from near the mouth of the Hootalinqua would tend to show a distinct value for this supposedly by-product. The dredging company of which Capt. Jack Crawford is the resident head has obtained considerably over 100 miles of rivers for gold dredging, part of which is a long stretch of the Hootalinqua near its mouth. In a test last Summer, fine gold was sluiced in paying quantities; but it is not of that gold we wish to speak. In washing a cubic yard and a half of gravel, the short sluice boxes became badly congested with black sand. The sand and gold dust were taken up and the gold carefully removed. The sand was not thrown away, as is usual, but brought to Dawson. Dr. Willis E. Everette, a metallurgist of national reputation and a member of the bar of the Supreme Court of the United States, is official assayer of Captain Jack's company and has a most complete and expensive assay office on Second avenue. The sand was given him for examination, and the most surprising results were obtained.

To commence at the beginning, it was readily found that 25 per cent of the black sand was not magnetic iron oxide. With magnets the two were easily separated, and between the two sands there was little difference except that the non-magnetic sand appeared of slightly finer grain than the magnetic. A furnace test of the magnetic sand was divided into lots, mixed with the proper fluxes and introduced into the furnace. At the proper heat all but the metals wanted were volatilized or ran into slag, leaving buttons of platinum and gold. A careful weighing upon scales which weigh to the one-forty-eight-thousandth part of a grain showed a most surprising result—a result which is bound to revolutionize sluicing methods as practiced to-day in river dredging. In one ton of the non metallic black sand there is $102 in gold and 96 ounces of platinum, some iridium, and a trace of tin. The platinum at $8 per ounce would amount in value to $768, making the total value of a ton of the sand $870.

In some localities the sand is most plentiful. In this case there were 12 pounds of black sand from a cubic yard and a half of bar gravel. In 12 pounds of black sand there were three pounds of the non-metallic sand. To obtain a ton of this gold and platinum bearing sand would, by the above figures, require the sluicing of 1,000 yards of gravel, which gives the value in platinum and gold of 87 cents per yard. This is entirely outside of any placer gold caught in the sluices or upon the amalgam. With dredgers, on a modern plan, it costs but a few cents to handle each yard of creek-bed gravel, so that if there was not an ounce of free gold in the country it would still be profitable to dredge for black sand.

Dr. Everette's own words are: "Forty cubic feet of gravel in place gave 12 pounds of black sand by the usual lixiviation process. This black sand assayed and analyzed gave a high value in gold and platinum, with traces of silver, copper, tin and iridium. The sample, when analyzed for platinum, gave the enormous amount of 96 ounces to the ton, the platinum being in the shape of finely divided minute grains of metal, combined with similar sized grains of excessively fine gold to the value of $102 to the ton." At the same operation with the above, Dr. Everette assayed some of the Hootalinqua gold and found it to run a trifle over $17 per ounce.

A Reported Steam Engine Combination.

It was rumored in New York city on Monday of last week that Joseph Hoadley, of the Autotruck company, was a prominent mover in a reported combination of six or eight manufacturers of stationary steam engines. It was said that the Corliss and Greene companies, of Providence, R. I., and the American Wheelock Engine Company, of Worcester, Mass., were included with several others whose names were not given. It was said that Edwin S. Cramp, the Philadelphia shipbuilder, would be a director in the alleged combination. Mr. Cramp for several years has been interested in the American Wheelock Engine Company. Several prominent engine manufacturers, when questioned by the ELECTRICAL REVIEW, were disinclined to take the matter seriously.

LATEST PROGRESS IN THE APPLICATION OF STORAGE BATTERIES.

READ BEFORE THE NEW YORK ELECTRICAL SOCIETY, JANUARY 12, 1899, BY JOSEPH APPLETON.

(Continued from page 85.)

The use of large water-powers as a motive power for generating stations from which electrical energy is transmitted and distributed over extended areas is growing. Take for example the Niagara and other plants. In connection with such installations, storage batteries play a very important part.

The power from such a plant is largely sold for manufacturing purposes, and is charged for at so much per horse-power per annum, the power being available 24 hours per day. While the mills and factories using this power do not usually run for more than 10 hours per day, therefore a man who requires a maximum of 100 horse power for 10 hours a day, or 1,000 horse power hours, really has to pay for 2,400 horse-power hours, while he uses only 1,000, and probably less, for the average rarely, if ever, exceeds 70 per cent of the maximum.

With a storage battery capable of supplying 50 horse-power for 10 hours, or 500 horse-power hours, he need only pay for one-half the amount or 50 horse-power for 24 hours, as the battery will furnish the remainder, and can be charged during the 14 hours he is not using the power. In addition to this, the battery will take care of any fluctuation above the average and enable the man to buy the average amount of power he requires instead of the maximum.

Such an installation has been made by the Buffalo Street Railway Company. Before describing this installation I would like to mention the different methods of installing storage batteries in connection with railway plants. These may be divided into two classes:

First—Where the battery is installed at the power-house to take care of the peak of the load and the fluctuation of the generators.

Second—Where the battery is installed at the end of a long feeder to keep up the pressure at that point and to obviate the necessity of sending the maximum amount of current over the long feeders from the power-house.

We will consider an installation of each kind and their respective methods of operation.

The Buffalo Street Railway Company's plant is of the first class, and is especially interesting, inasmuch as it is operated in connection with the Niagara Falls power. They operate practically all the cars within the city limits, and have a steam plant capable of delivering 7,000 electrical horse-power, in addition to which they take 2,000 horse-power from the Niagara Falls power, this current being transmitted in the form of high-tension alternating current from the Niagara Falls to the power-house and being then transformed by rotary converters to the ordinary 550-volt direct current.

The storage battery is installed at the main power-house and is connected directly in parallel with the steam plant and rotary converters.

When a storage battery is installed at the power-house, and is connected directly in parallel with the generators on the busbars, some means have to be provided for regulating the voltage of the battery to suit the generators. As you know, railroad generators are overcompounded, the voltage rising as the load increases; while with the storage battery the reverse is the case, the voltage decreasing as the discharge increases. In order to make the battery work properly in parallel with generators of this type and take the fluctuations of the load, keeping the generators constantly loaded, some means of compounding the battery has to be adopted. This is done by using a compound-wound booster in series with the battery, which is so designed as to increase its voltage in proportion to the increase of load, thereby enabling it to take its proper share and keep the load on the generators constant.

The following slides show the Buffalo power-house battery room and the booster and switchboard. Also a load curve showing the method of using the battery and the part it plays in the general plan of operation.

The battery discharges during the morning and evening peak, and is charged between times, and also at night from the Niagara Falls power.

By the aid of the battery they are enabled to make very much more use of the Niagara Falls power. Before they installed the battery they were only able to shut down their steam plant from 11.30 P.M. until 5 A.M., during which time the rotary converters carried the entire load, which averaged about 600 horse-power, while they were paying for 2,000 horse-power. With the aid of the battery they are enabled to shut down their steam plant from 7 P.M. to 7 A.M., and about 18 hours on Sunday. In addition to this they are enabled to utilize very much more of the Niagara power.

An illustration of the second method of using storage batteries for railroad work is seen in the case of the battery installation of the South Side Elevated Railway Company, of Chicago.

This company operates an elevated road about nine miles long, all their trains being equipped with the Sprague multiple-unit system. The power-house is located approximately at the center, and the two storage batteries near each end of the line, and are connected directly across the system without a booster. The charge and discharge of these batteries is controlled by the drop over the feeders from the power-house to the batteries; this drop varying, according to the load on the system, from 10 to 80 volts. When the load on the system is light, the drop in the feeders is

small, and there is voltage enough to charge the battery. When the load becomes heavy the drop on the feeders is increased; this consequently causes the batteries to discharge into the line. The method of operating is entirely automatic, the batteries discharging at times of heavy load, and charging at times of light load, thereby keeping the load on the generating station practically constant. The following slides illustrate these two battery rooms, in each of which are installed 248 cells, having a capacity of 1,000 horse-power when discharging at the hour rate. The following curves show the result which the batteries have had on their generating plant.

The first curve shows the load on the generators when they were operating the entire system without batteries.

The second curve shows the load on the generators, under the same conditions, with the batteries in use.

The other two curves show the operation of the battery at this time, which is the time of heaviest load or the "peak" of the system.

It will be noticed from these curves that when the power-house was operating without the battery during the peak of the load the maximum load was 7,500 amperes, with sudden fluctuations of 5,300 amperes, while with the batteries in operation the maximum load at the power-house, under exactly the same conditions, was 5,700 amperes, and the fluctuations only 2,000 amperes. Thus, the batteries had increased the capacity of the power-house by about 2,000 amperes, and steadied the load on the generators to the extent of nearly 3,000 amperes.

Those acquainted with the operations of railway plants will appreciate such results. The way in which a battery operates under such conditions and takes up the fluctuations automatically is plainly seen by the curves, showing the readings on the annunciators in the battery circuit.

Each battery is connected to the power-house by two special feeders, in addition to the general system of conductors, so that the proportion of charge and discharge can be regulated according to the conditions of the load.

If it is found that a battery is being discharged more than it is being charged, an extra feeder is connected between it and the power-house, so that it will be relieved of a portion of the load. By this means a very complete control can be maintained of the battery from the power-house, and the most efficient method of operation secured.

A battery installed at the end of a line in this way not only increases the capacity of the power-house and saves the investment in copper by making it only necessary to transmit over the feeders the average amount of current required, instead of the maximum, at the same time maintaining the proper voltage at the end of the line, thereby enabling the motors to run at the point of highest efficiency. Of course the line must be long enough to justify the use of a storage battery and to supply sufficient drop in voltage over the feeders to make the battery operate automatically as the load varies.

A variation in voltage at the end of the line, between conditions of maximum load and minimum load of 10 per cent, is ample to make the battery self-regulating and take care of the fluctuating load without a booster. The following figures, taken from a storage battery installation of this description, installed some two years ago, will show the advantages from a commercial point of view.

The conditions were as follows: The length of this line, at the end of which the battery was installed, was seven miles from the main power-house, running into the suburbs of a large city. The increase of traffic on this line warranted its extension four miles further, making a total of 11 miles from the power-house. When the extension was made it was found that the feeders were quite inadequate to carry the increase of load, and it was necessary to provide additional power at the end of the line, either by laying extra feeders, installing a small power-house at that point, or putting in a storage battery substation. Each method was carefully considered, and the following figures show the result. If additional feeders were laid of sufficient sectional area to provide the proper working voltage at the end of the line, the cost would have been $273,000, figuring on the basis of $1 per foot, laid for 1,000,000 circular mils feeders. This was, of course, prohibitive. The cost of a small power-house of sufficient capacity to take care of the load, in that section, of 750 kilowatts would have been $85,000.

The cost of a battery substation complete, including real estate, was $33,000, or a saving of $52,000 over that of the power plant.

The cost of operation has proved exceedingly satisfactory, showing a saving of some $1,350 per month, or $16,000 per annum over the cost of operating a power-house of such a size. The cost of operation includes all attendance, taxes, depreciation and interest.

One of the most interesting and important storage-battery installations recently made is that in connection with the underground trolley system of the Metropolitan Street Railway Company, of New York city. Their system covers a large area, and they have utilized storage batteries in substations. Two are now in operation, one at the foot of West Twenty-third street and the other at Thirty-second street and Fourth avenue.

By the kind permission of the Metropolitan Street Railway Company, any of the members of the New York Electric Society and their friends, who care to do so, may inspect the Twenty-third street plant after the meeting to-night.

I will briefly outline this plant and method of operation, and will leave the details until we are on the ground. The battery consists of 540 cells, each containing 51 plates, 15 inches square. The dimensions of the cells are 4 feet by 21 inches by 24 inches. The battery is divided into two sections, 270 cells in each, which are operated in parallel. This is done to keep the size of the cells within practical limits, and to enable them to be more easily inspected and cared for. A cell eight feet in length, which would be the size if only one battery was used, is too large to be satisfactory.

The capacity of the complete battery is 8,000 ampere hours, with a one-hour rate of 4,000 amperes.

The function of this battery is to take care of a portion of the morning and evening peaks, and to take up the fluctuations of load at all times. The method of operation is as follows:

Sufficient cells are provided so that the voltage of the battery just balances the average voltage of the system, consequently, when the battery is connected to it, it acts as an equalizer and does not charge or discharge, except as the fluctuations occur. When the battery discharges on a peak and is being charged during the hours of light load a booster is connected in series with it to regulate the amount of charge and discharge. The output of the booster and, consequently, the charge and discharge of the battery are controlled by varying the strength and polarity of the shunt field. This is done by a special form of switch, which makes the operation very simple. This slide shows the switch and also a switchboard, which is very similar, although not exactly the same. The daily work of the battery is about as follows:

From 7 to 9 A.M. it discharges on the peak. From 9 A.M. to 12 M. it floats on the system as an equalizer. From 12 to 3 or 4 P.M. it is charging. From 4 to 8 P.M. it discharges on the peak. From 8 P.M. to 12 midnight it is floating on the system, and after midnight the battery is given its principal charge, this being continued until the battery is full.

This will give an idea of the installation and of the general plan of operation. I will go more fully into the details when we visit the plant.

We will now consider the use of storage batteries in connection with isolated plants in large office buildings and stores using electric elevators.

The modern office building, with its 15 or 20 stories, together with the demand for quick elevator service, has greatly increased the use of high-speed electric elevators.

The nature of the work the elevator has to perform, and the fact that the power required to start it is from two to three times the hoisting power, causes the elevator load to be an extremely fluctuating one, no matter how carefully the operation is watched.

The Commercial Cable Building in this city is an excellent example of what can be done with the operation of an electric plant of this description. The building is wired for about 3,500 16 candle-power lamps, 240 volts, and has six screw-type high-speed Sprague elevators. The generating plant consists of two 300-horse-power water-tube boilers, two 225 horse-power engines directly connected with two 150-kilowatt generators, and the storage battery consists of 120 cells, each containing 27 plates, 15½ inches by 15½ inches. The capacity of this battery is as follows:

At 260 amperes....1620 ampere hours.
" 520 amperes....1040 ampere hours.
" 650 amperes....for the 1 hour rate.

The function of this battery is to take care of the fluctuating elevator load during the daytime when the plant is running—that is, between 9 A. M. and 9 P. M.—and at night to supply the whole current required for lighting and the occasional trips of one elevator.

Before the battery was installed it was found necessary to run one generator for the lighting circuit, and one for the elevator circuit, the fluctuations of the latter causing the lamps to be unsteady if both were run from the same machine. The method of operation is as follows:

The elevator circuit is connected directly across the terminals of the battery and the battery is being constantly charged by means of a constant-current booster, which boosts the current from the lighting generators. By a special winding on this booster the amount of current it allows to pass from the generator to the battery and elevators is maintained practically constant.

For example, with a fluctuation of 600 amperes in the elevator circuit, the load on the generators is increased by about 50 amperes, or less than 10 per cent, this amount having no effect on the steadiness of the lamps. The amount of current boosted in this way is the average elevator load for the time the plant is running, plus the amount of current required to charge the battery after it has carried the previous night's entire load.

The curves herewith show graphically the operation of this plant. The lower curve shows the fluctuating load on the battery, which varies from 350 amperes discharge to 300 charge. Of course, when there is no elevator load, which occasionally happens (all the elevators standing still), the entire amount of current passed through the booster is used for charging the battery. When a heavy elevator load comes on, this boosted current is diverted from charging the battery into the elevator circuit, the battery discharging in parallel with it as may be required. In this installation the booster is passing about 250 amperes, thus when the battery was discharging at 350 amperes, the total elevator load was 350 plus 250, or 600 amperes. The second curve shows the variation of the load on the generator at the same time. This, you will notice, reaches the maximum of 70 amperes, while the voltage on the lamps is maintained practically constant, the curve being almost a straight line. Such an application is an ideal one for a storage battery, as it not only decreases the size of the generating plant required, but enables the generating plant, when it is running, to be operated at a steady and economical load, instead of a fluctuating one.

(To be concluded.)

ADVANCE INFORMATION

New Electric Railways.

EDWARDSVILLE, ILL.—The Alton & East Alton Railway and Power Company has been incorporated with a capital of $100,000. Incorporators, Joseph B. Porter, C. A. Caldwell, O. S. Stowell, H. C. Priest, Geo. M. Ryan and H. S. Baker. The company will do a general street railway and power business.

HARTFORD, CT.—The Woodbury & Southbury Electric Railway Company has been organized at Woodbury with a capital stock of $50,000. James Huntington has been elected president, and E. S. Boyd secretary and treasurer. The road will run through Waterbury, Woodbury and Southbury.

TACOMA, WASH.—Articles of incorporation of the Tacoma Railway and Power Company have been filed in the office of the Secretary of State at Trenton, N. J. The capital stock is $2,000,000, and the incorporators are Gordon Abbott, Charles E. Cutting, C. H. Coster, Bird S. Coler, T. Jefferson Coolidge, Jr., Samuel Carr and S. Endicott Peabody. The company will furnish electricity from water-power to the street railroads and factories of Tacoma.

New Incorporations.

WATERVILLE, ME.—The Atlantic Manufacturing Company has been organized. The capital stock of the company is $100,000, of which $40,000 has been paid in cash. The directors are Charles E. Bibber, Herbert W. Smith, Boston; Cyrus W. Davis, Waterville. The company will manufacture and handle electrical supplies, having its headquarters in Mansfield, Mass.

NEWARK, N. J.—The Middlesex Electric Company has been incorporated to manufacture electricity; capital $100,000. Incorporators, Manning Freeman, John M. Conner, Herbert C. Richardson, Metuchen; Willard S. Muchmore, Frederick G. Agens, Jr.

NEWARK, N. J.—The Economic Light and Power Company has been incorporated to manufacture electricity for light and power; capital, $100,000. Incorporators, Horace M. Decker, Richmond C. Coventry, Frederic M. Payne.

BOSTON, MASS.—The Massachusetts Construction Company has been incorporated to manufacture electric railways; capital stock, $150,000. Incorporators, Chas. G. Kidd, president, and Wallace D. Lovell, treasurer.

EL DORADO SPRINGS, MO.—The El Dorado Springs Electric Company has been incorporated; capital, $15,000. Incorporated by C. A. Ross, F. W. Hyatt and A. P. Nichols.

JERSEY CITY, N. J.—The Columbia Electric Car Lighting and Brake Company has been incorporated to manufacture, etc., gas and electricity and machinery used therefor; capital, $2,000. Incorporators, Edgar W. Youmans, Robert B. Upham, Kenneth K. McLaren.

TRENTON, N. J.—The Electric Boat Company, with an authorized capital of $10,000,000, has been incorporated. The company is empowered to construct and operate steamships and other vessels. The incorporators are Charles Blizard, William H. Palmer and Augustus Treadwell.

CINCINNATI, OHIO—The Rahn & Mayer Company has been incorporated, with $30,000 capital stock, to manufacture machine tools, by Charles F. Mayer, W. H. Carpenter, John Rahn, Jr., A. C. Rahn and Charles J. Hunt.

NEW YORK, N. Y.—The Incandescent Trading Company has been incorporated to manufacture lamps; authorized capital, $5,000; paid in, $500. Incorporators, R. H. Porter, E. A. Freshman, J. C. Wall.

Increase of Capital.

NEW YORK, N. Y.—The Empire City Subway Company, Limited, has increased its stock from $1,500,000 to $1,750,000.

BENTON HARBOR, MICH.—The capital stock of the Twin City Telephone Company, of this place, has been increased from $25,000 to $50,000.

Electric Light and Power.

TACOMA, WASH.—The Tacoma Railway and Power Company has been incorporated; capital stock is $2,000,000. The company will furnish electricity from water-power to the street railroads and factories of Tacoma.

MORRISTOWN, N. J.—The Babbitt Heat and Power Company has been incorporated to supply heat and power; capital, $25,000. Incorporators, Oscar H. Babbitt, Robert D. Foote, Richard B. Moriarity.

MASSENA, N. Y.—The Massena Electric Light and Power Company has been incorporated with a capital of $10,000. The directors are Thomas H. Gilespie, R. A. Johnston and E. M. Stathers, of New York city; Henry W. Merwin, of Brooklyn, and Robert Swan, of Massena.

ST. REGIS FALLS, N. Y.—St. Regis Falls Electric Light Company has been incorporated; capital, $2,000. Incorporators, H. E. O'Neil, W. T. O'Neil, W. B. Babcock.

WATERLOO, N. Y.—Citizens' Heat, Light and Power Company has been incorporated. Incorporators, G. W. Dawson, J. D. Easton, G. E. Lichty, J. E. Sedgwick, C. W. Mullan, W. W. Miller, C. E. Pickett, F. C. Platt.

HOBOKEN, N. J.—The North River Light, Heat and Power Company has been incorporated with a capital stock of $300,000; incorporators, A. R. Bonta, A. Seitz and W. C. Anderson.

New Telephone and Telegraph Companies.

LITTLE VALLEY, N. Y.—The Little Valley Telephone Company has been incorporated to operate a telephone line in towns in Cattaraugus County; capital, $500; directors, S. W. Bendient, of Little Valley, and others.

FARMVILLE, VA.—A local telephone company is being organized here with great promise of success. S. P. Vanderslice is interested.

MONTGOMERY, MO.—The Montgomery Telephone Company has been incorporated; capital stock, $3,000; incorporated by A. B. Chance, John W. Jackson, E. A. Kemper and others.

JEFFERSON CITY, MO.—The Oregon & Forest City Telephone Exchange has been incorporated; capital stock, $1,000; incorporated by D. M. Martin, Thomas L. Price, C. J. Hunt and others.

RED SULPHUR SPRINGS, W. VA.—The Red Sulphur Springs, Peterstown & Union Telephone Company has been incorporated; capital, $5,000; incorporators, W. H. Ballard, C. M. Spangler, J. E. Hansberger, R. F. Fleshman, J. A. Meadows.

BALTIMORE, MD.—The Maryland Telephone Company has been incorporated by Messrs. Henry A. Parr, George R. Webb, Pinkney W. Wilkinson, Thomas F. McGlone and John Waters, with a capital stock of $1,250,000.

WINCHESTER, KY.—The Winchester, Ford & Richmond Telephone Company has been incorporated; incorporators, S. T. Prewitt, David Prewitt and D. L. Pendleton. The company will build a telephone line from here to Richmond by way of Ford.

TRENTON, MO.—The Trenton Telephone Company has been incorporated, with a capital stock of $8,000; incorporated by W. W. Bain, J. B. Wright, E. M. Harbor and others.

The Harrison Primary Cell.

The No. 1 Harrison cell is announced as a practically new departure in primary cells, for, while peroxide of lead has long been used in connection with storage batteries, it has never before been successfully used in a primary cell. The other materials used in the Harrison cell have been adopted after years of experiment. The mechanical construction of the cell is as near perfection as intelligent effort can make it. Every point has been carefully worked out with two ends in view; viz., simplicity and stability. A reduced facsimile of the cell is shown on this page.

The combination in a primary cell of lead peroxide and zinc amalgam with dilute sulphuric acid as the electrolyte gives the highest electromotive force (2.45 volts) obtainable in a practical primary cell. The quick depolarization obtained by the use of specially prepared lead peroxide along with the low resistance of the electrolyte and its high voltage makes the Harrison cell, the manufacturers claim, the most powerful open-circuit cell ever devised. The amount of work it will do is extraordinary when its size is taken into consideration. The small size of the cell (it is only five inches high by three inches square) is one of its commendable features. Where space is a consideration, the Harrison cell is most suitable, as it occupies only a fraction of the space required for the usual type

THE HARRISON PRIMARY CELL.

of open-circuit wet cell. The ratio is about one to six for the same output. Its high voltage reduces by more than one-half the number of cells required for a given purpose when compared with the usual type of cell. Its cleanliness in operation, the absence of creeping salts and corroded connections, its freedom from freezing in cold weather and liability to destruction by short-circuiting, along with the cheapness of its maintenance and renewals, are all admirable points of favor.

It is estimated that the cost of the electrical energy obtained from this cell is about one cent per watt hour. This battery will give on ordinary open-circuit work a discharge of 40 ampere hours or over 80 watt hours.

The cell is adapted for all kinds of open circuit work and will keep its charge indefinitely when standing idle, as there is no local action on open-circuit to cause deterioration. The cell is made by Harrison Bros. & Company, Incorporated, Philadelphia, and the Thermo-Electric Company, Times Building, New York, are the sole agents.

Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED FEBRUARY 7, 1899.

618,848 Electric arc lamp; W. E. Dennis, New York, N. Y.

618,853 Brush-holder for dynamo-electric machines; G. S. Dunn, East Orange, N. J.—Consists of a commutator, a brush-holder, rigging centered upon the axis of the commutator and revoluble in a circle concentric thereto, and brush-holder supports mounted upon the rigging and independently adjustable thereon circumferentially around the commutator, and adjustable together around the commutator by the movement of the rigging.

618,864 Apparatus for operating electric brakes; H. S. Grabep, St. Louis, Mo.—Consists of a storage battery, an electric motor, a charging and motor-operating circuit in which they are arranged in series an electro-magnet permanently out of circuit with the motor, a second circuit receiving no electricity from the first circuit, and in which said battery and magnet are arranged, and means for opening and closing the second circuit.

618,876 Circuit breaker and closer; A. T. Hill, Detroit, Mich.

618,911 Trolley connection for canal boats; F. J. Shewring, Toronto, Can.

618,920 Electric hand-lighting gas burner; H. C. Thomson, Boston, Mass.

618,935 Rotating electric motor; W. P. Freeman, New York, N. Y.—Consists of a suitable standard, a motor pivotally mounted thereon and turning on annular friction-reducing bearings, a yielding and pivotal connection for one of the terminals of the motor in the axial line of said bearings and a concentric contact ring and brush for the other of said terminals.

618,950 Lightning arrester; E. C. Parham, Johnstown, Pa.—Consists of two pairs of normally-separated electrodes and means for simultaneously increasing the gap between one of said pairs and closing the gap between the other of said pairs, when current is flowing through the device.

618,993 Electrical battery; L. Paget, New York, N. Y.—A battery having a metallic retaining vessel, with a metallic electrode which fits snugly within said vessel, said electrode and the inner surface of the vessel being amalgamated.

619,014 Electric arc lamp; T. E. Drohan, Chicago, Ill.—A carbon-holder, a mounting therefor permitting the same to be moved away from its normal position to permit the lamp to be trimmed, switching mechanism controlling the continuity of the lamp-circuit, and a connection between said carbon-holder and switching mechanism, whereby the latter is automatically actuated by the movement of said carbon-holder.

619,023 Torpedo-controlling device; W. D. Litchfield Somerville, Mass. — In a vessel having a propelling mechanism and steering mechanism operated by power generated or stored within the vessel, two step-by-step devices carried by the vessel for controlling said mechanisms and operated by the making and breaking of two circuits at a distance from the vessel.

619,028 Electro-chronograph; C. W. Thompson, La Crosse, Wis.

619,034 Switch-handle for telephone calls; O. R. Cline, El Dorado, Kas.—An operating crank for magneto-cells, consisting of a bushing, a contact sleeve united firmly to said bushing and insulated electrically therefrom, and a spring controlled crank mounted movably upon the bushing and normally engaging with the sleeve.

619,038 Automatic electric signal for railway crossings; U. J. Fry, Milwaukee, Wis.

619,090 Electric arc lamp; A. Schweitzer, Allegheny, Pa.

619,091 Automatic magnetic circuit-breaker; W. M. Scott, Philadelphia, Pa.

619,100 Electric crane; W. R. Thomas, Catasauqua, Pa.

619,125 Drilling machine; R. Binnie, Bolivar, Pa.

619,157 Composite signaling and transmission system; S. D. Field, Stockbridge, Mass.—A composite system of one telephonic circuit and three telegraphic circuits, formed of two main conductors, the said conductors serving severally as the line conductors of two of the telegraphic circuits, being connected in parallel to constitute the third telegraphic circuit, and being connected in series to constitute the metallic telephone circuit.

619,187 Prepayment mechanism for electric meters; J. C. Kinney, San Antonio, Tex.

619,217 Electric motor; O. H. Pieper, Rochester, N. Y.—An annular magnet for motors, embodying two sections, each composed of separate plates secured together and having the projections forming the interior pole-pieces and the exterior depressions, the ends of said plates lapping, means for securing the lapped ends together and the bearing-plates on the magnet opposite the exterior depressions.

619,240 Toll counter or register for telephonic circuits; G. K. Thompson, Malden, Mass.

TRADE NOTE.

Jagabi Portable Testing Sets—Merit is bound to count if one has sufficient patience, and the increasing demand for Jagabi portable testing sets simply confirms this idea. The Jagabi set was placed on the market some months ago, and has forced its way to the front rank simply because it sustains the claims of the manufacturers, and proves itself to be a thoroughly reliable and satisfactory instrument for resistance measurements within certain understood limits. The set is made by Messrs. Willyoung & Company, and handled exclusively by Mr. James G. Biddle, Drexel Building, Philadelphia, who makes a specialty of high-class testing instruments. Mr. Biddle has recently received a number of testimonial letters from users of the Jagabi portable testing set, and it may be interesting to note the two following:

GOVERNMENT TELEGRAPH SERVICE,
DEPARTMENT OF PUBLIC WORKS,
Dominion of Canada.

OFFICE OF THE GENERAL SUPERINTENDENT,
OTTAWA, ONT., 2d February, '99.

JAMES G. BIDDLE, Esq., 910 Drexel Building, Philadelphia, Pa.

DEAR SIR: In response to your inquiry, we have two sets of the "Jagabi" apparatus in use, giving perfect satisfaction; and so far as my experience goes, the instrument is one of the best made and most convenient of its kind obtainable. I am, dear sir, yours faithfully,

(Signed) D. H. KEELEY,
General Superintendent.

THE SOMERSET LIGHTING COMPANY.

SOMERVILLE, N. J., January 27, 1899.

MR. JAMES G. BIDDLE, Philadelphia, Pa.

DEAR SIR: In reference to the testing set purchased recently from you, our experience with the instrument in question has been of a very satisfactory nature. It is an accurate instrument and will compare favorably with apparatus of this nature now on the market. The ease, accuracy and flexibility of the instrument will recommend it to any one having use for such apparatus. Yours, &c.,

THE SOMERSET LIGHTING COMPANY.
(Signed) C. R. K.

The Jagabi portable testing set is fully described in Mr. Biddle's catalogue B, "Electrical Measuring Instruments," which will be mailed to interested parties upon receipt of 10 cents in stamps.

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Kindred.... ...Interests

The H. T. Paiste Company, Philadelphia, makers of electric light supplies, are sending to their friends a very tasteful calendar, embellished with an artistic engraving.

The Shively-Mullinix Electric Company, of Hamilton, Ohio, has been formed with C. L. Mullinix and J. D. Shively at the head. The company manufactures electrical specialties, including the line of brushes made by the Mullinix Electric Company, of Cincinnati. The company will also take up electrical construction and will carry a complete line of electrical supplies, for which quotations from manufacturers are requested.

Mr. James G. Biddle, Drexel Building, Philadelphia, has just received a large order from the United States Government covering a set of fine electrical testing instruments for measuring insulation, capacity and resistance of cables. This outfit will be placed on the U. S. cable-ship "Panama," which is about to sail from New York for the Philippine Islands. The above shows that the cable testing apparatus handled by Mr. Biddle, and for which he has had large demand during the past year, is right up to date in every respect. Engineers and others interested in such matters should communicate with Mr. Biddle.

Empire City Subway Company.

A certificate of increase of the capital stock of the Empire City Subway Company, Limited, of New York city, from $1,500,000 to $1,700,000 has been filed with the Secretary of State. The certificate is attested by John W. Lieb, Jr., and John H. Cahill, chairman and secretary of the stockholders' meeting. The amount of capital of the corporation actually paid in is $1,424,000, and the whole amount of its liabilities is $4,071,434.

ITEMS OF INTEREST.

A German firm has secured the contract to install an electric-light plant in Bangkok, Siam.

Mr. J. W. Marsh, general manager of the Standard Underground Cable Company, Pittsburgh, was a visitor to New York city last week.

One of the liveliest daily exchanges that comes to this office is the Toronto, Can., *World*. It keeps almost up to the times technically as well as politically.

There is a tradition, says *Power*, of a student who applied to Lord Kelvin for a definition or explanation of the term "entropy." The reply is said to have been, "It was a very bad name for it."

Edward E. Proctor, of Wakefield, Mass., has purchased the gas and electric-light plant at Greenville, and will enlarge and improve the electric-light plant with new machinery at a cost of from $15,000 to $20,000.

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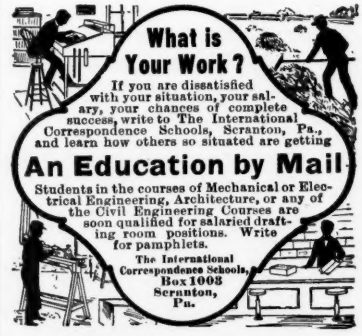
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